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Health and Safety Plan for Vapor Vacuum Extraction with Treatment for OU 7-08, Organic Contamination in the Vadose Zone

Bruce P. Miller / Kelly Wooley

December 2003

Idaho Completion Project

Bechtel BWXT Idaho, LLC

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Bruce P. Miller
Vortex Enterprises, Inc.
Idaho Falls, Idaho

Kelly Wooley
BBWI

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Idaho Completion Project
Idaho Falls, Idaho 83415

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Approved by

Lisa A. Harvego
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Lisa A. Harvego, Bechtel BWXT Idaho, LLC
Project Manager, Organic Contamination in the Vadose Zone

12/10/03
____
Date

ABSTRACT

This health and safety plan supercedes revision *5* of the previous health and safety plan for the Organic Contamination in the Vadose Zone Project.

This health and safety plan establishes the procedures and requirements that will be used to eliminate or minimize health and safety risks to personnel working at the vapor vacuum extraction with treatment units and associated monitoring of Operable Unit 7-08, the Organic Contamination In The Vadose Zone (OCVZ) Remediation Project, located at the Subsurface Disposal Area within the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory. These procedures and requirements are established in accordance with the Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response standard. Personnel conducting preventive maintenance, sampling, and associated activities related to the Organic Contamination In The Vadose Zone Remediation Project are required to comply with requirements of this plan. This plan specifically contains information about the hazards involved in performing the work, as well as actions and equipment that will be used to protect workers while conducting the project tasks.

The intent of this plan is to identify known and potential hazards that may be encountered during project tasks and to state the necessary mitigation requirements to eliminate or minimize the hazards. Safety and health professionals supporting these activities must determine the most appropriate hazard control and mitigation measures, based on site-specific conditions, and should revise this plan, as deemed appropriate, to meet the field conditions encountered. This plan will be augmented with other work control documents for specific tasks and operations.

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FIGURES

TABLES

ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
Anti-C	anti-contamination
APR	air-purifying respirator
CERCLA	Comprehensive Environmental, Response, Compensation and Liability Act
CFA	Central Facilities Area
CFR	*Code of Federal Regulations*
CPR	cardiopulmonary resuscitation
DAC	derived air concentration
dBA	decibel A-weighted
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EPA	U.S. Environmental Protection Agency
ERO	Emergency Response Organization
FTIR	Fourier-transform-infraredspectrometer
GDE	guide
GI	gastrointestinal
HASP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSO	health and safety officer
IARC	International Agency for Research on Cancer
ICP	Idaho Completion Project
IDLH	immediately dangerous to life or health
IH	industrial hygienist

INEEL	Idaho National Engineering and Environmental Laboratory
ISMS	Integrated Safety Management System
ITP	individual training plan
JSA	job safety analysis
LEL	lower explosive limit
LO/TO	lockout and tagout
MCP	management control procedure
MSDS	material safety data sheet
NFM	nuclear facility manager
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NTP	National Toxicology Program
OEL	occupation exposure limits
OMP	Occupational Medical Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCM	personal contamination monitor
PDD	program description document
PEL	permissible exposure limit
PLN	plan
PPE	personal protective equipment
PRD	program requirements document
RadCon	Radiological Control
RCM	Radiological Control Manual
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician

RW	radiological worker
RWP	radiological work permit
SRPA	Snake River Plain Aquifer
STD	standard
STEL	short-term exposure limit
SWP	safe work permit
TCE	tetrochlorethene
TLV	threshold-limit value
TPR	technical procedure
TWA	time-weighted average
UV	ultraviolet
VOC	volatile organic compound
VPP	Voluntary Protection Program
VVET	vapor vacuum extraction with treatment
WAG	waste area group
WCC	Warning Communications Center
WMF	Waste Management Facility

Health and Safety Plan for Vapor Vacuum Extraction with Treatment for OU 7-08, Organic Contamination in the Vadose Zone

1. WORK SCOPE

1.1 Purpose

The intent of this health and safety plan (HASP) is to identify known and potential hazards that may be encountered during Operable Unit (OU) 7-08 organic contamination in the vadose zone (OCVZ) vapor vacuum extraction with treatment (VVET) operations at the Subsurface Disposal Area (SDA) within the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL). In addition, this HASP identifies necessary mitigation requirements to eliminate, control, or minimize these hazards. These procedures and requirements are established in accordance with the Occupational Safety and Health Administration (OSHA) *Code of Federal Regulations* (CFR) standard, "Hazardous Waste Operations and Emergency Response" (HAZWOPER) (29 CFR 910.120). Personnel conducting preventive maintenance, sampling, and associated activities related to the OU 7-08 Project are required to comply with the requirements of this HASP. This HASP contains specific information about hazards involved in performing the work as well as actions and equipment used to protect personnel conducting the project tasks and has been written to meet the requirements of the HAZWOPER (29 CFR 1910.120).

1.2 Applicability and Jurisdiction

Project operations are within the jurisdiction of the Balance of INEEL Cleanup (BIC) Operations Director. This plan governs all tasks performed at the OCVZ Project by management and operating contractor employees, subcontractors, employees of other companies, and personnel from U.S. Department of Energy (DOE) laboratories. Personnel not normally assigned to work at the project (e.g., representatives of DOE, State of Idaho, OSHA, and the U.S. Environmental Protection Agency [EPA]) are considered nonworkers who fall under the category of occasional site workers, as defined by OSHA (29 CFR 1910.120), and will be permitted onsite only for official business.

Project operations will be conducted under the administrative controls of the applicable documented safety analysis.

1.3 Site Description of the Idaho National Engineering and Environmental Laboratory

The INEEL, formerly the National Reactor Testing Station, encompasses 2,305 km^2 (890 mi^2), and is located approximately 55 km (34 mi) west of Idaho Falls, Idaho (see Figure 1-1).

The U.S. Atomic Energy Commission, the predecessor of DOE, established the National Reactor Testing Station in 1949 as a site for nuclear testing and for building a variety of nuclear facilities. The INEEL also has been the storage facility for transuranic radionuclides and radioactive low-level waste since 1952. Transuranic waste is defined as radioactive waste containing any alpha-emitting radionuclide with an atomic number greater than 92, a half-life longer than 20 years, and a concentration greater than 100 nCi/g at the end of an assumed period of 100 years of institutional control.

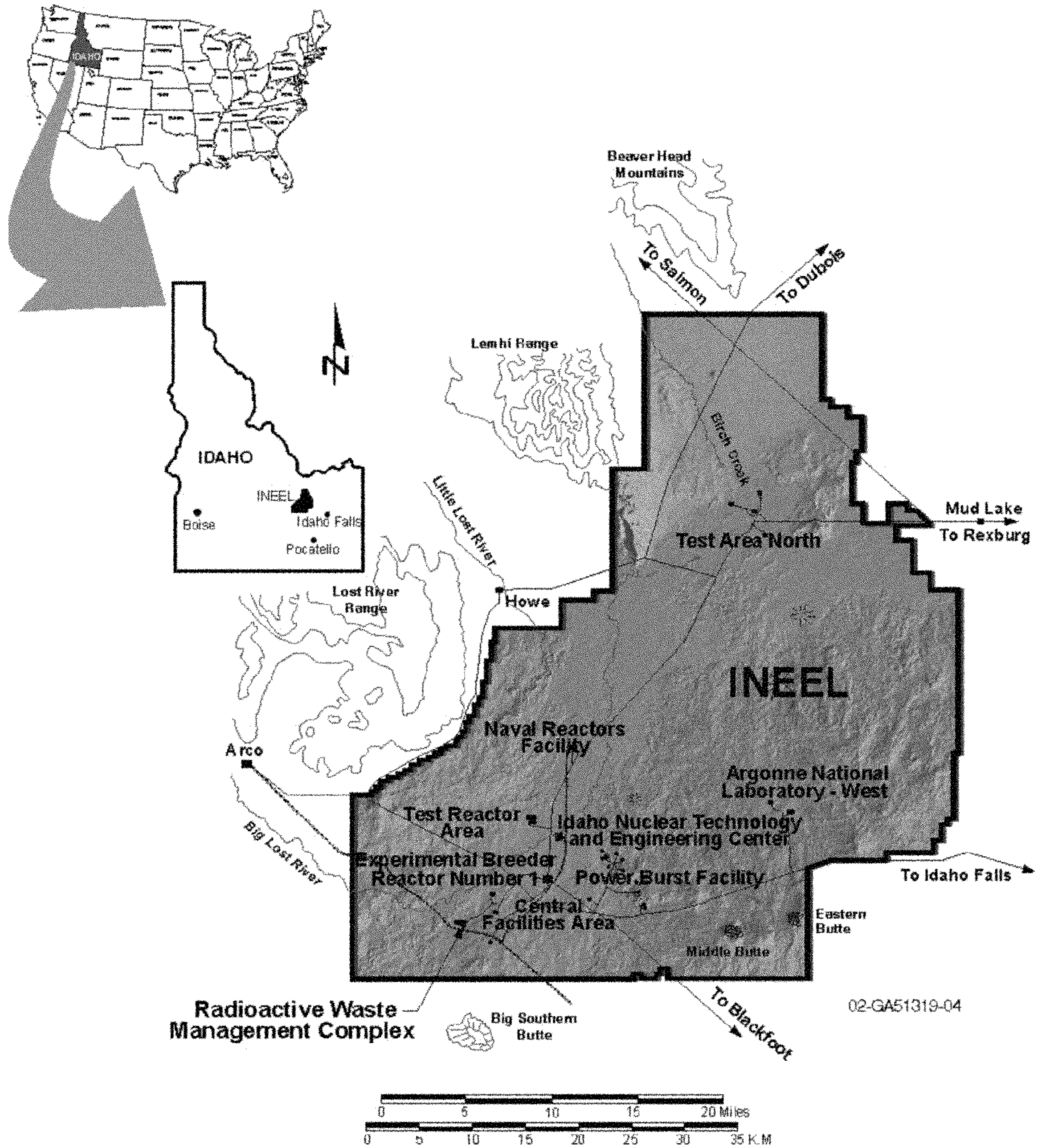

Figure 1-1. Map of the Idaho National Engineering and Environmental Laboratory showing the Radioactive Waste Management Complex and other major Site facilities.

At present, the INEEL supports DOE engineering and operations efforts, and other federal agencies, in areas of nuclear safety research, reactor development, reactor operations and training, nuclear defense materials production, waste management technology development, and energy technology and conservation programs. The **U.S.** Department of Energy Idaho Operations Office (DOE-ID) has responsibility for the INEEL and designates authority to operate the INEEL to government contractors. Bechtel BWXT Idaho, LLC, the current primary contractor for DOE-ID at the INEEL, provides managing and operating services to the majority of INEEL facilities.

1.4 Background and Description of the Radioactive Waste Management Complex

The RWMC was established in the early 1950s as a disposal site for solid low-level waste generated by operations at the INEEL and other DOE laboratories. Radioactive waste materials were buried in underground pits, trenches, soil vault rows, and one aboveground pad (Pad A) at the SDA. Transuranic waste is kept in interim storage in containers on asphalt pads at the Transuranic Storage Area. Radioactive waste from the INEEL was disposed of in the SDA starting in 1952. Rocky Flats Plant (RFP)[a] transuranic waste was disposed of in the SDA from 1954 to 1970. Post-1970 transuranic waste is kept in interim storage in containers on asphalt pads at the Transuranic Storage Area.

In August 1987, in accordance with Section 3008(h) of the Resource Conservation and Recovery Act (RCRA) (42 USC § 6901 et seq.), the DOE and EPA entered into a Consent Order and Compliance Agreement (DOE-ID 1987). This Agreement required DOE to conduct an initial assessment and screening of all solid and hazardous waste disposal units at the INEEL and to establish a process for conducting any necessary corrective actions. On July 14, 1989, the EPA[b] proposed that the INEEL be listed on the National Priorities List (54 FR 29820). The final rule that listed the INEEL on the National Priorities List was published on November 21, 1989, in 54 FR 48184. On December 4, 1991, because of the INEEL's listing on the National Priorities List, DOE, EPA, and the Idaho Department of Health and Welfare entered into the Federal Facility Agreement and Consent Order for the INEEL (DOE-ID 1991). This agreement and consent order established the procedural framework and schedule for developing, prioritizing, implementing, and monitoring response actions at the INEEL in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) (42 USC § 9601 et seq.), RCRA, and the Idaho Hazardous Waste Management Act (HWMA 1983).

1.5 Description of the Subsurface Disposal Area

The SDA (see Figure 1-2) comprises individual storage and disposal areas consisting of pits, trenches, aboveground storage pads, and soil vaults. The presence of organic contaminants in the vadose zone beneath the RWMC resulted from the burial and subsequent breach of containerized organic waste, primarily from the Rocky Flats Plant,‘ in several of the pits and trenches. The organic waste was mixed

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a The Rocky Flats Plant, located 26 km (16 mi) northwest of Denver, Colorado, was renamed the Rocky Flats Environmental Technology Site in the mid-1990s. In the late 1990s it was again renamed to its present name, the Rocky Flats Plant Closure Project.

b This was done under the authority granted by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) (42 USC § 9601 et seq.), as amended by the Superfund Amendments and Reauthorization Act of 1986 (Public Law 99-499).

c. The Rocky Flats Plant is located 26 km (16 mi) northwest of Denver. In the mid-1990s, it was renamed the Rocky Flats Environmental Technology Site. In the late 1990s, it was again renamed to its present name, the Rocky Flats Plant Closure Project.

with calcium silicate to reduce free liquids and form a very thick, greaselike material, which was typically double bagged and placed in drums before disposal. In addition, small amounts of absorbent, such as Oil-Dri, were normally mixed with the waste to bind free liquids. The organic waste consisted of lathe coolant, used oils, and degreasing agents such as carbon tetrachloride (CCl_4); 1,1,1-trichloroethane; trichloroethene (TCE); tetrachloroethene; hydraulic oil; gearbox oil; spindle oil; Freon; and Varsol (Clements 1982). The containers have deteriorated over time, allowing volatile organic compound (VOC) contaminants to migrate into the vadose zone. Subsequently, the vadose zone has become contaminated with VOCs and trace levels of CCl_4 have been detected in the underlying Snake River Plain Aquifer (SWA).

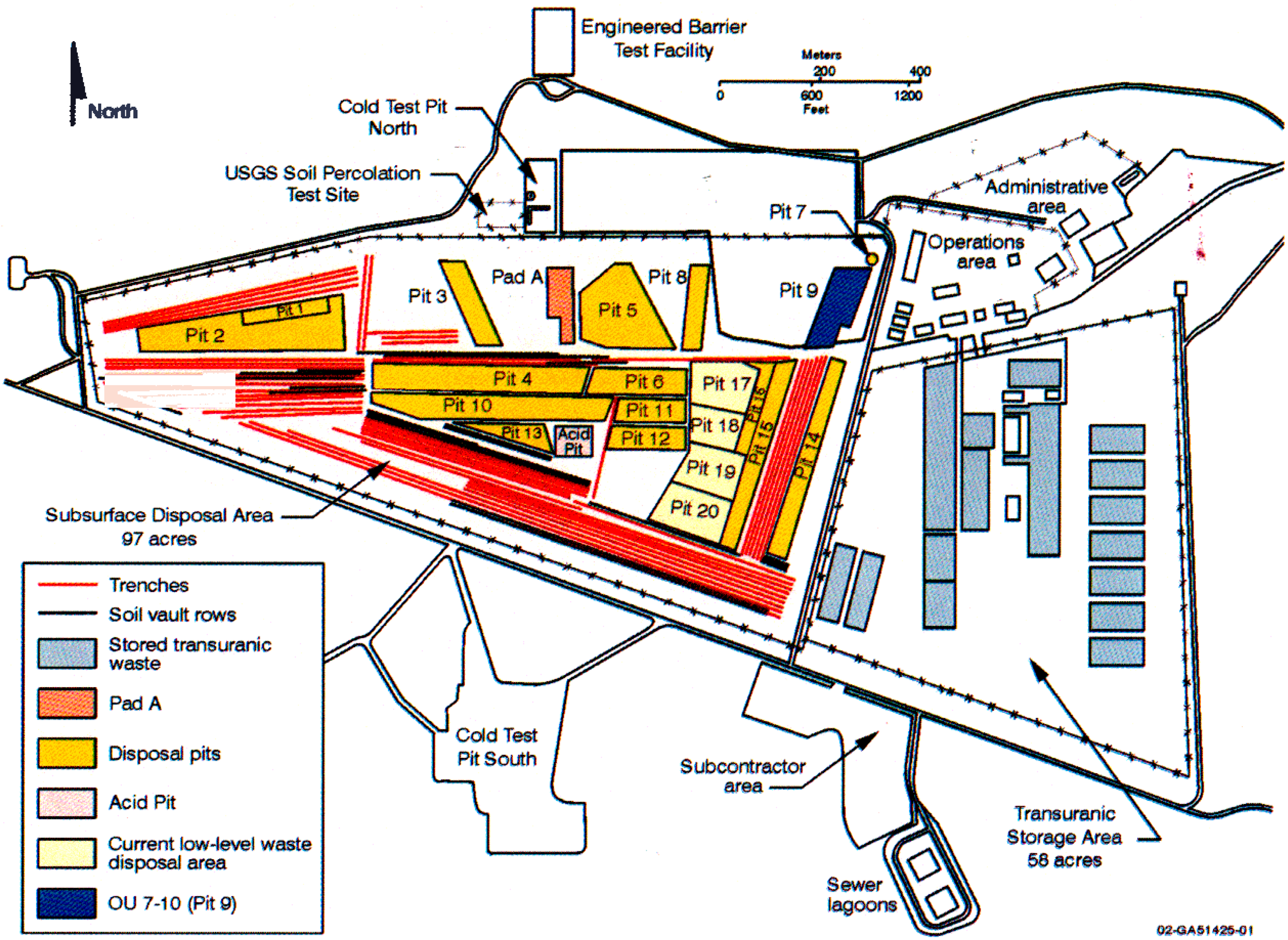

Figure 1-2. Map of the Radioactive Waste Management Complex showing the location of the Subsurface Disposal Area.

1.6 Operable Unit 7-08 Site Description

The OCVZ OU 7-08 is defined as that part of the unsaturated zone that is potentially contaminated by VOCs beneath the boundaries of the SDA. The vadose zone, which contains VOCs, begins at the ground surface and extends to the top of the saturated zone of the SWA, approximately 183 m (600 ft) below land surface. The OCVZ OU 7-08 does not include the buried pits and trenches of the SDA.

The vadose zone contains VOCs, primarily in the form of organic vapors, that have migrated from organic waste disposed of in pits at the SDA. A remedial action will be conducted in accordance with requirements set forth in the *Record of Decision: Declaration for Organic Contamination in the Vadose Zone–Operable Unit 7-08* (DOE-ID 1994). In accordance with this Record of Decision, the selected remedy consists of extracting and destroying organic contaminant vapors present in the vadose zone beneath and within the immediate vicinity of the RWMC. Monitoring the vadose zone vapors and the SWA in the vicinity of the RWMC are also specified in the OU 7-08 Record of Decision. The major components of this remedial action consist of the following activities:

- Installing and operating vapor extraction wells in addition to the preexisting vapor extraction well
- Installing soil vapor monitoring wells in addition to the preexisting vapor monitoring wells
- Installing, operating, and maintaining VVET units to collect and destroy organic contaminants by using an off-gas treatment technology for vapor removed by extraction wells.

1.6.1 Volatile Organic Compounds in Subsurface

Figure 1-3 shows the location of Series 743 waste drum burials, which are the primary source of VOCs in the SDA. Volatile organic compound contaminants have been released from the waste into the vadose zone, creating a large vapor plume that extends from land surface to the SWA. Figure 1-4 is a conceptual drawing of the vadose zone VOC plume based on CCl_4 vapor samples. The drawing represents the plume before any remedial actions.

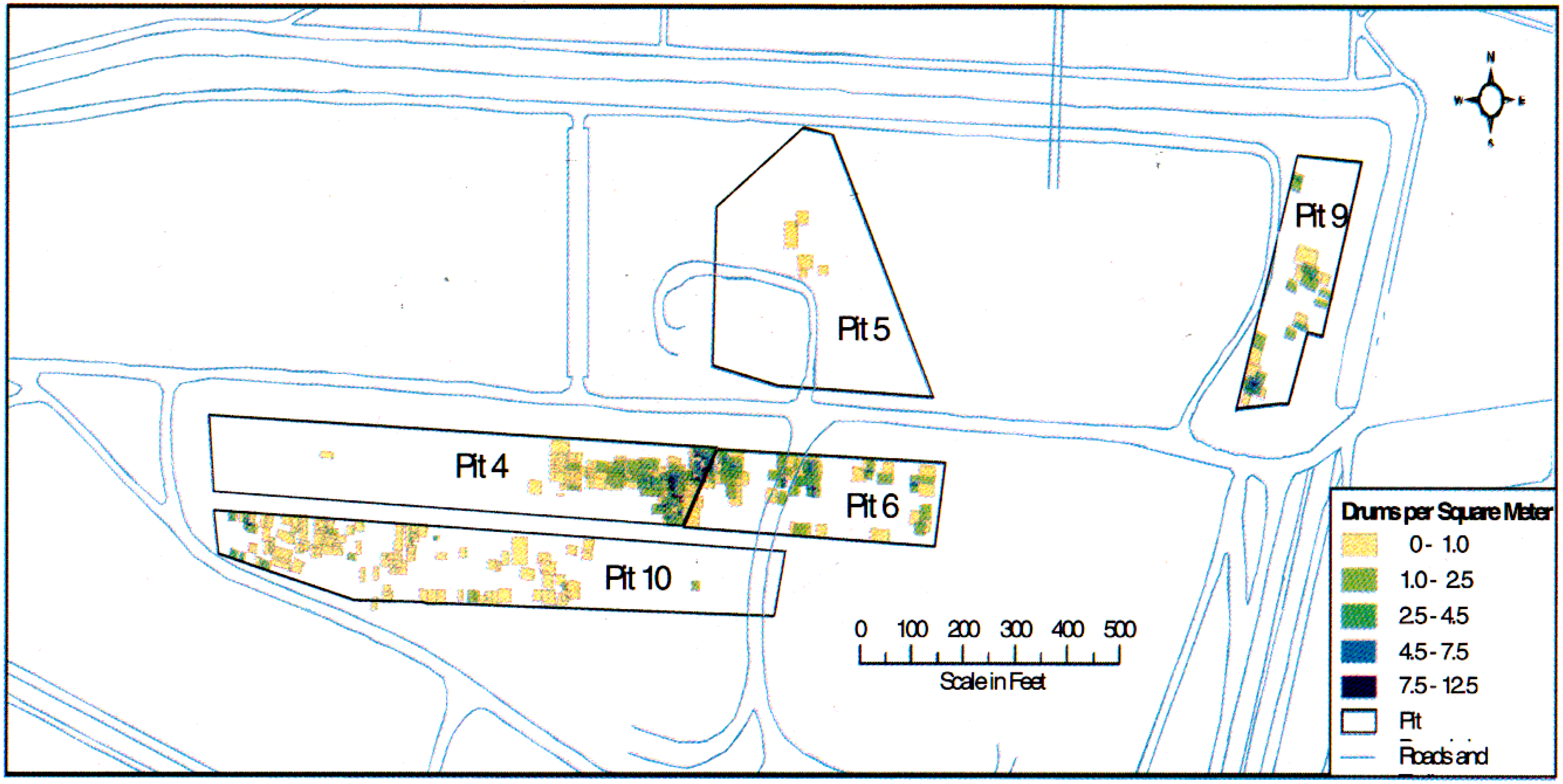

Figure 1-3. Map of the Subsurface Disposal Area showing relative drum-burial densities for Series 743 waste drums.

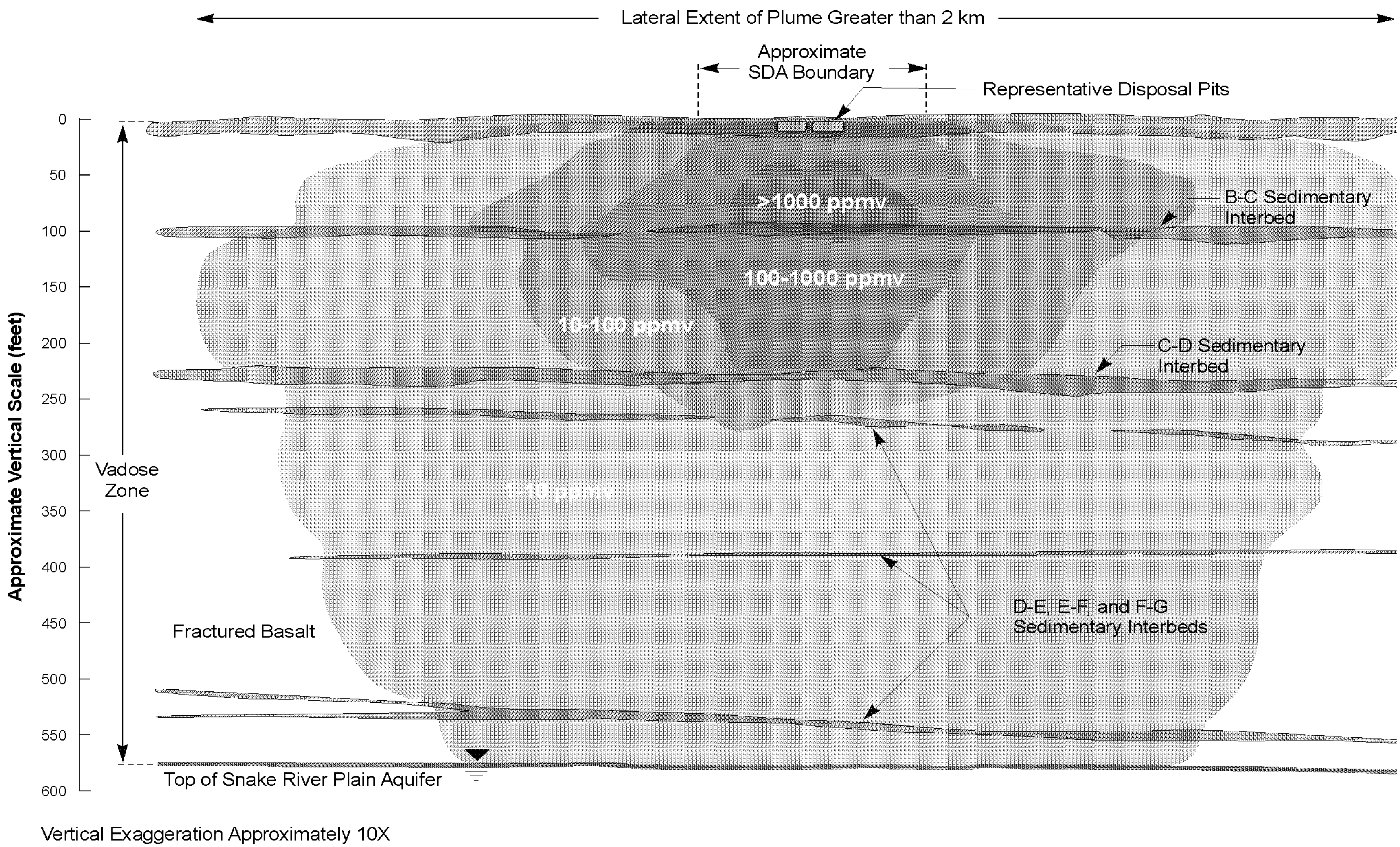

Figure 1-4. Conceptual drawing of the volatile organic compound plume before remedial operations.

1.6.2 Vapor Vacuum Extraction with Treatment Oxidation Process

The VVET process can be divided into three basic operations: (1) pretreatment, (2) catalytic oxidation, and *(3)* stack release of the oxidizer exhaust gas. Three VVET units (Units D, E, and F) operate within the boundaries of the SDA. The three VVET units extract vapor from wells located in the SDA, treat the vapor using catalytic oxidation, and vent the oxidation products out an exhaust stack. A diagram of the catalytic oxidation system is provided in Figure 1-5. A map of the SDA with the general locations of the VVET units and extraction wells is provided in Figure 1-6.

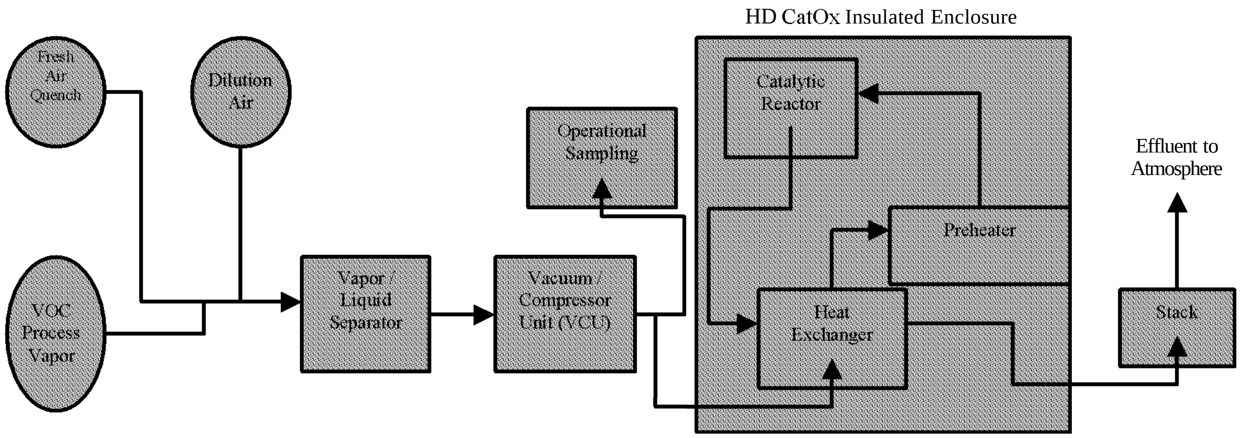

Figure 1-5. Block diagram of catalytic oxidation system.

1.6.2.1 Pretreatment. The function of the pretreatment equipment is to collect extracted VOC vapor into a header using a vacuum blower. Vapor from VOCs is withdrawn from the well head and carried to the skid through insulated piping. Supplemental heat is provided to the flowing vapor to minimize condensation of vapors in the transfer lines. Each manifold is configured to accept feed from multiple well locations. The fraction of feed withdrawn from any given well is controlled through the flow control valves on the respective well lines. The vapor flow rate from each extraction well is measured upstream of the manifold connection. Total vapor pressure, temperature, and flow are monitored and controlled in the main vapor header, upstream of the oxidizer.

1.6.2.2 Oxidation. The catalytic oxidation systems elevate the vapor temperature by an external source to the set-point temperature of the process. At this temperature, halogenated compounds are destroyed in a catalytic reaction. Before exiting the catalyst, the vapor passes through a heat exchanger to recover heat from the outlet stream. Recovered heat is used to help preheat the catalyst inlet stream of the process vapor. The primary reaction product is HCl.

1.6.2.2.1 ***Post-Treatment—***Oxidation products are exhausted from the VVET units through approximately 9-m (30-ft) stacks. Extensive air-emission-impact modeling was performed to determine ambient and occupational air-quality impacts from the OU 7-08 remedial action, as discussed in the OCVZ Remedial Design/Remedial Action Work Plan (LMITCO 1995c, Appendix E), and in compliance with applicable or relevant and appropriate requirements. Based on oxidizer inlet concentrations and the destruction-removal efficiencies of the units, the treatment activities are compliant with applicable or relevant and appropriate requirements, and post-treatment will be unnecessary.

Complete details of the emission-modeling technique, meteorological conditions, and results (including worker exposure and exposure risk assessment) were developed in an engineering design file, "Operable Unit 7-08 Air Dispersion Modeling and Health Effects from Thermal Oxidation Unit Emissions at the Radiological Waste Management Complex (EDF-190l)."

In addition, the concentrations of VOC constituents and HCl are monitored at the ground level using open-path Fourier-transform-infrared (FTIR) spectrometers. Collected data provide an indication of worker exposure to various hazardous materials. The open-path FTIR spectrometer data are used in conjunction with dispersion modeling to provide an estimate of total emissions from each of the oxidizer units.

1.6.3 Installation of Extraction and Monitoring Wells

To implement the selected remedy described in the *OU 7-08 Record of Decision* (DOE-ID 1994), 15 vapor extraction and monitoring wells were installed in or near the SDA during 1994. In addition, one existing extraction well (i.e., Well 8901D) and five existing monitoring wells (i.e., Wells D02, 8801, 8902, 9301, and 9302) were incorporated for extracting and monitoring VOC vapors. In 2000, Wells DE-1, M17S, 6E, and 7E were installed to provide additional extraction and monitoring of VOC vapors. During FY 2003, Wells SE6, IE6, DE6, SE7, IE7, DE7, SE3, IE3, DE3, SE8, IE8, DE8, IE4, and DE4 were installed in more strategic locations to provide added extraction capability at varying depths. Figure 1-6 shows the well locations.

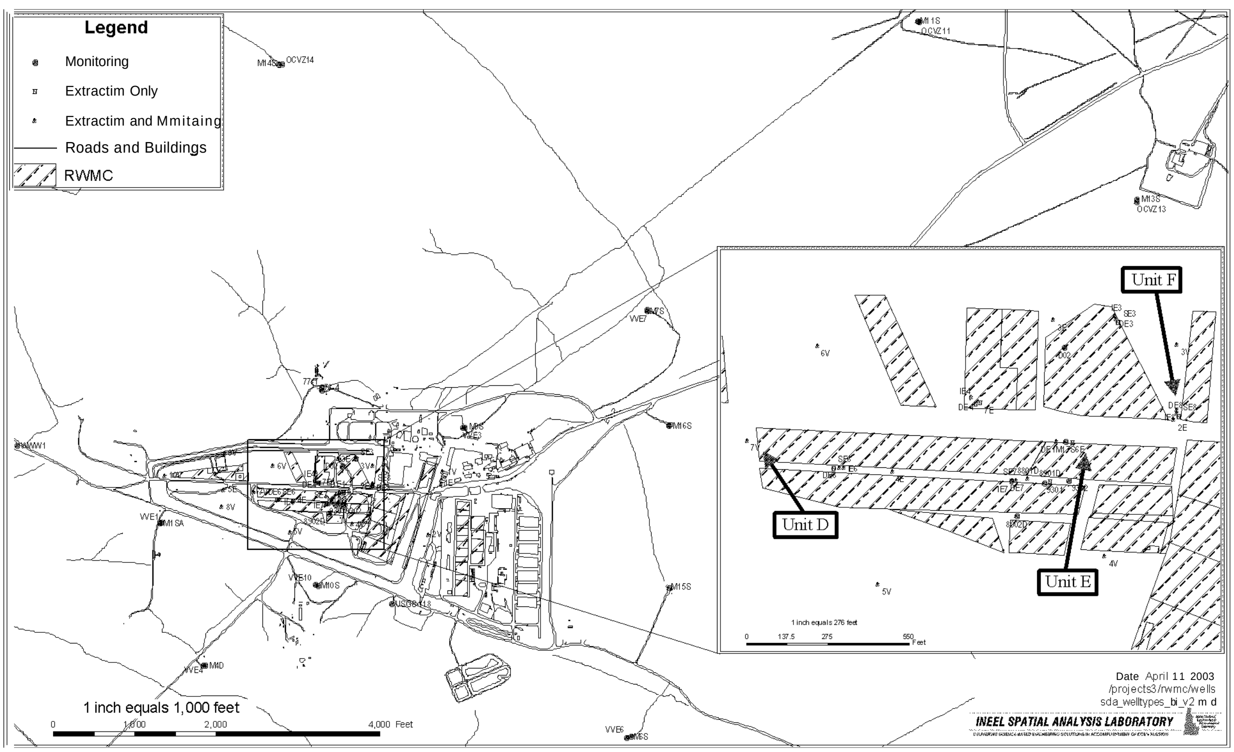

Figure 1-6. Vapor vacuum extraction with treatment extraction- and monitoring-well locations.

1.7 Scope of Work

The purpose of the remedial action program is to extract and destroy the organic contaminants from the vadose zone beneath and within the immediate vicinity of the SDA. In addition, the selected remedy includes monitoring of the vadose zone vapor and the SRPA. The general objective of this remedial action is to reduce the risks to human health and the environment associated with the organic contaminants present in the vadose zone and to prevent federal and state drinking water standards from being exceeded after the 100-year institutional control period.

The following tasks have been identified under this scope of work:

- Vapor vacuum extraction with treatment unit operation, maintenance, construction, and upgrade activities
- Sampling and analysis
- General housekeeping.

1.7.1 Vapor Vacuum Extraction with Treatment Unit Operation, Maintenance, Construction, and Upgrade Activities

Technicians, engineers, and facility craft support personnel perform VVET operations and maintenance as described in the *Operations and Maintenance Plan for OCVZ* (McMurtrey and Harvego 2001). Routine, periodic, and occasional emergency maintenance is required for VVET systems or components as part of normal operation, including (but not limited to) changing filters, lubricating equipment, and replacing worn or broken parts and components.

Full-time system technicians and engineers maintain and monitor unit operations during the 4-day, 10-hour/day workweek. The technicians schedule and oversee routine maintenance, collect effluent samples, complete operations logs and reports, and perform troubleshooting activities when necessary. Operations activities also have involved system modifications, upgrades, inspections, and procedure and work-order development and revision.

1.7.2 Sampling and Analysis

Sampling and analysis activities are completed to support the OCVZ remedial action objectives. The *Field Sampling Plan for OCVZ Operations and Monitoring* (Housley 2003) was written to implement the sampling requirements defined in the OCVZ data quality objective process (INEEL 2002). These activities include operational, environmental, and occupational sampling and analysis, and are discussed in the following sections.

1.7.2.1 Operational Sampling. Samples are collected from the inlet of each of the VVET units and are analyzed using a Briiel and Kjaer Photoacoustic Gas Analyzer, Model 1302 (or equivalent) for the five analytes of concern, including chloroform; 1,1,1-trichloroethane; tetrachloroethene; TCE; and CCl_4.

1.7.2.2 Flux-Chamber-Vapor Monitoring. Flux-chamber-vapor monitoring is performed at the treatment units directly above buried waste in known VOC radiological (i.e., hot spot) areas and in background areas (INEEL 2002). This provides flux data to estimate residual source mass remaining in the pits and determine concentrations and quantities of organic contaminants being extracted from the vadose zone. The flux chamber is a vented hood that is fitted over surface soils. During operation, the contained gases are pulled, by way of a vacuum, through a carbon dioxide detector, where vapors are analyzed for VOC concentration. The sampling frequency is once a month at four sampling locations. Flux chamber sampling data provide more defensible estimates of the amount of VOCs that escape to the atmosphere and help determine the diffusion parameters used in the VOC fate and transport model.

1.7.2.3 Soil Gas Surveys. Shallow-soil gas measurements are focused over the three primary areas known to contain the largest amounts of VOCs (INEEL 2002). Soil gas surveys are performed by installing monitoring tubes into the shallow sedimentary soils in the areas immediately adjacent to and above the SDA buried waste in known hot-spot areas. The soil gases are swept up the monitoring tubes and analyzed by an online VOC detector. Alternatively, the soil gases can be collected in a container (e.g., a Tedlar bag) for onsite and off-INEEL laboratory analysis. The sampling is conducted up to four times per year at each location, and the duration of sampling at each location depends on the sample results. Data from this sampling are used to (1) estimate the residual source-mass release traits and trends by transient observations of shallow soil gas, (2) establish spatial and temporal changes in shallow-soil gas, and *(3)* determine whether the pits continue to contribute mass to the vadose zone. Data would indicate locations, and whether the source mass is generally increasing, decreasing, or constant.

7.7.2.4 Collection of Monitoring Samples. *Field-sampling activities are conducted in accordance with the* Field Sampling Plan for Operations and Monitoring Sampling Conducted in Support of the OCVZ Remediation Project *(Housley* 2003). *Monitoring samples are collected to support optimization* ***of*** *WET operations and to assess effectiveness* ***of*** *the remedial action. Currently, samples are collected for periodic monitoring (i.e., monthly and quarterly) and are planned to be collected during the compliance-verification and long-term monitoring periods (INEEL 2002).*

1.7.2.5 Periodic Monitoring. Periodic monitoring samples are collected from various depths in numerous vapor ports, extraction wells, and groundwater-monitoring wells located throughout the SDA to determine the effect that treatment is having on the vadose zone. Samples are analyzed in the onsite laboratory using a multigas photoacoustic (or equivalent) instrument during initial monitoring. Data from monitoring samples are used to (1) estimate mass reduction, (2) optimize the operating systems, *(3)* establish spatial and temporal distribution of the VOCs in the vadose zone, and (4) support the decision to shut down active extraction activities.

1.7.2.6 Compliance-Verification Monitoring. The compliance-verification phase, following VVET system shutdown, is when the vadose zone will be monitored to verify that vapor concentrations remain within acceptable limits under natural pressure conditions within the vadose zone. During the compliance-verification phase, monitoring is performed on a monthly basis for a minimum period of 1 year. Monitoring results provide the data necessary to determine whether the VVET system can be restarted or shut down, thereby initiating the long-term monitoring phase. Data from the compliance verification phase are input into the fate and transport model and used to develop control charts for individual sampling locations.

1.7.2.7 Long-Term Monitoring. The long-term monitoring phase is the last phase planned for the OCVZ Project and will be initiated after the final VVET shutdown decision has been made. Samples for this phase will be collected semiannually. If subcontractor-sampling results fall within the control limits defined for all locations for ***3*** successive years, then the sampling frequency will be reduced to a single annual event at each location. The data obtained during this phase will be used to verify that the vadose zone VOC concentrations remain within the allowable control limits or provide justification to restart the VVET system.

1.7.3 Housekeeping.

Good housekeeping plays a key role in the control of health and safety hazards. Housekeeping activities to be performed at the site include, but are not limited to, the following:

- Clear scrap, waste material, and debris from work areas, passageways, and ladders

- Remove vegetation surrounding the units
- Remove snow and ice, as necessary.

The RWMC laborers generally perform these tasks as maintenance-related tasks.

1.8 Program Interfaces

The interface agreement between the RWMC and Balance of INEEL Cleanup Project (BIC) (IAG-20) has been established to define the roles, responsibilities, approvals, and authorities between the BIC and the Radioactive Waste Management Complex for all BIC activities, including OCVZ operations, conducted in and around the general area of the RWMC facility. Construction activities associated with OCVZ activities will be covered under a Project Boundary Interface Agreement (PBIA).

This project operates as a facility under the purview of the Balance of INEEL Cleanup Project Director. Project operations will be conducted in accordance with applicable requirements documented safety analysis, this HASP, interface agreement(s), project operating procedures, and work orders.

2. HAZARD IDENTIFICATION AND MITIGATION

The purpose of this hazard identification and mitigation section is to lead the user to an understanding of the occupational safety and health hazards associated with OCVZ Project tasks. This will enable project management, safety and health professionals, and workers to make effective and efficient decisions related to the equipment, processes, procedures, and the allocation of resources to protect the safety and health of all personnel.

2.1 Hazard Recognition, Evaluation, and Control Strategy

The OU 7-08 Project VVET operational activities include the following:

- Conducting routine inspections and operational checks of VVET units
- Collecting operational and environmental samples
- Constructing and upgrading VVET units
- Performing scheduled and unscheduled unit maintenance and housekeeping activities
- Interfacing with subcontractors and vendors supporting VVET operations and maintenance.

These operational and maintenance activities present physical and potential chemical and radiological hazards to personnel conducting these activities. Identification and mitigation of these hazards is imperative to prevent injury or exposure to personnel and ensure safe operations. The primary objectives of this section are to (1) provide a systematic approach to identify existing and anticipated hazards based on these operational and maintenance activities, (2) evaluate the potential risk these hazards present, and *(3)* describe the controls to eliminate or mitigate these hazards. This approach includes the following:

- Evaluating project operational and maintenance activities to determine the extent that potential industrial safety, radiological, nonradiological, and physical hazards may affect personnel
- Determining necessary engineering controls, isolation methods, administrative controls, work practices, and (where these measures will not adequately control hazards) personal protective equipment (PPE) to hrther protect project personnel from hazards
- Establishing monitoring and sampling required to evaluate exposure and contamination levels, to determine action levels to prevent exposures, and to provide specific actions to be followed if action levels are reached
- Describing required personnel for hazard-identification and -control training.

Elimination or isolation of hazards through engineering controls will be primary means to control hazards wherever feasible. Where hazards cannot be eliminated or isolated with engineering controls, administrative controls, work procedures, and PPE will be implemented to hrther mitigate potential exposures and hazards to operational and maintenance personnel.

Engineering controls will be implemented in addition to work procedures, real-time monitoring of contaminants, and project facility-specific hazard training to hrther mitigate potential hazards and exposures. Formal preplanning (e.g., job walk-down, completion of the hazard-profile-screening and prejob-briefing checklists, JSAs, and Guide [GDE] –6212, "Hazard Mitigation Guide for Integrated Work Control Process") and other work controls will be written based on hazards identified in this HASP; technical procedures; Standard (STD) -101, "Integrated Work Control Process"; work packages; and operational conditions. These documents will specify specific operational hazard-mitigation measures to follow. This hazard mitigation strategy will be used to eliminate or mitigate project hazards in accordance with Program Requirements Document (PRD) -25, "Activity Level Hazard Identification, Analysis, and Control," to the extent possible.

2.2 Nature and Extent of Contamination

Contaminant concentrations have been detected in surface soils, underlying basaltic and sedimentary interbeds, perched water, and the groundwater within Waste Area Group (WAG) 7, which comprises the RWMC. Data tentatively support the conclusion that some contaminants may have migrated from the SDA through the vadose zone and into the SRPA (Becker et al. 1998).

Detected concentrations of contaminants of potential concern in surficial soils and the vadose zone are presented in the *Interim Risk Assessment and Contaminant Screening for the WAG 7 Remedial Investigation* (Becker et al. 1998). Sample depths, concentration ranges, and comparisons to surficial sediment background values and risk-based concentrations are given along with the number of samples collected and the number of analytical results above detection limits. Results from vadose-zone samples collected under the SDA provide evidence of contaminant release and migration. Radionuclides detected in the vadose zone include Am-241, Co-60, Cs-137, Eu-152, Pu-238, Pu-239/240, U-234, U-235, and U-238. Nonradiological contamination detected in the vadose zone includes acetone, antimony, 2-butanone, CCl_4, chloroform, manganese, mercury, methylene chloride, nickel, tetrachloroethene, 1,1,1-trichloroethane, TCE, tributylphosphate, and toluene.

Several investigations have been conducted since 1987 to determine the nature and extent of VOC contamination in the soil gas in the vicinity of the SDA. In summary, 10 contaminants of potential concern have been detected in SDA-area soil gas. These contaminants of potential concern include acetone, benzene, 2-butanone, CCl_4, chloroform, methylene chloride, tetrachloroethene, toluene, 1,1,1-trichloroethane, and TCE. The VOCs are locally ubiquitous in the soil gas at the SDA. The primary contaminants are CCl_4, chloroform, and TCE, with CCl_4 being the most prevalent. The contamination extends vertically from the land surface down to the water table, and laterally more than 1 km (0.62 mi) beyond the SDA boundary. The highest concentrations (3,000–5,000 [ppm) have been measured between Pits 4, 6, and 10 in the center of the SDA above the B-C (33.5-m [110-ft]) interbed. In this region, concentrations increase with depth down to the B-C interbed and then decrease down to the C-D (73.15-m [240-ft]) interbed. The maximum lateral extent of contamination is undefined, but the concentrations diminish with distance from the SDA.

Tables 2-1 and 2-2 identify potential hazards that may be encountered during project operations, based on known SDA waste inventory and project activities, which state the associated hazard-specific mitigation measures.

2.2.1 Routes of Exposure

Exposure pathways exist for radiological and nonradiological contaminants that will be encountered during project operations. Engineering controls, monitoring, training, and work controls will mitigate potential contact and uptake of these hazards to a large extent; however, the potential for exposure remains.

Table 2-1 Evaluation of dominant nonradionuclide and radionuclide compounds to be used or that may be encountered during the Organic Contamination in the Vadose Zone Project.

Compound (CAS#, Vapor Density, and Ionization Energy)	Exposure Limit” (PEL/TLV)	Routes of Exposure[b]	Symptoms of Overexposure[c] (Acute and Chronic)	Target Organs and Systems	Carcinogen? (Source)[d]	Exposure Potential (All Routes)
Subsurface Disposal Area nonradionuclide organic waste constituents that may be detectable in overburden soils and other chemicals to be used at the project site[e]						
Acetone (67-64-1) VD = 2 E = 9.7eV	TLV = 500 ppm STEL = 750 ppm	Ih, Ig, Con	Nervous system, respiratory, dermis, headache; contact with eyes may cause permanent damage	Respiratory system, skm	No	**Low-negligible potential** (Source has been detected in previous vapor samples, but is not a dominant solvent in waste inventory. Source llkely would be encountered in a vapor form only.)
2-Butanone (78-93-3) VD = 2.5 E = 9.54eV	TLV = 200 ppm STEL = 300 ppm	Ih, Ig, Con	Irritation of eyes, skm, nose; headache; dizziness; vomiting; dermatitis	Eyes, skm, respiratory system, lungs, central nervous system	No-NIOSH No-ACGIH	**Low-negligible potential** (Source has been detected in previous vapor samples, but is not a dominant solvent in waste inventory. Source llkely would be encountered in a vapor form only.)
Carbon Tetrachloride (56-23-5) VD = 5.3 E = 11.5eV	TLV = 5 ppm STEL = 10 ppm OSHA ceiling = 25 ppm	Ih, Ig, S, Con	Nervous system, eyes, respiratory; irritation of eyes and skin; central nervous system, depression, headache	Central nervous system, eyes, liver, lungs, kidneys	A2—ACGIH (2000) Yes—NTP Yes—IARC No—OSHA	**Moderate potential** (Concentrations are relatively high in RFP sludge waste forms. Source llkely would be encountered in a vapor form only—direct exposure. Sampling data has shown some elevated levels.)
Chloroform (67-66-3) VD = 4.1 E = 11.4eV	TLV-10 ppm OSHA ceiling = 50 ppm	Ih, Ig, S, Con	Nervous system, eyes, respiratory, dermis, headache	Liver, ludneys, heart, eyes, skm	Yes-NTP Yes-IARC No-OSHA	**Low potential** (Source term is from RFP sludge waste forms. Source likely would be encountered in a vapor form only.)
Diesel fuel (68476-34-6) VD = 1.0 IE = NA	TLV: 100 mg/m^3 (ACGM – diesel fuel as total hydrocarbons, vapor or aerosol)	Ih, Ig, S, Con	Eye irritation; respiratory system changes; dermatitis	Eye, respiratory system	No	Fuel handling during refueling of diesel powered equipment.

Table 2-1. (continued)

Compound (CAS#, Vapor Density, and Ionization Energy)	Exposure Limit" (PEL/TLV)	Routes of Exposure[b]	Symptoms of Overexposure[c] (Acute and Chronic)	Target Organs and Systems	Carcinogen? (Source)[d]	Exposure Potential (All Routes)
Diesel exhaust (particulate aerodynamic diameter <1 μm)	None (Withdrawn from ACGIH 2003 Notice of Intended Changes)	Ih	Respiratory, nose, throat or lung irritation with stinging and redness of the eyes; headache; nausea; dizziness; unconsciousness	Respiratory system	No	Exhaust from excavator and other diesel-powered equipment.
Methylene chloride (75-09-2) VD-2.9 IE-11.3 eV	TLV = 50 ppm PEL = 25 ppm STEL = 125 ppm (29 CFR 1910.1052)	Ih, Ig, S, Con	Headache, dizziness, skin irritation	Skin, central nervous system, eyes, cardiovascular system	Yes-NTP Yes-IARC No-OSHA	**Low potential** (Source term is from RFP sludge waste forms. Source likely would be encountered in a vapor form only.)
Propane (74-98-6)	TLV = 2,500 ppm PEL = 2,000 ppm	Ih, Con	Gaseous: Dizziness, confusion, excitation, asphyxia; liquid: frostbite	Central nervous system (from asphyxiation)	No	**Low potential** (A potential exists for source to be found in vendor deliveries and positive seal transfer to tanks.)
Tetrachloroethylene (127-18-4) VD-5.8 IE-9.3 eV	TLV = 25 ppm STEL = 100 ppm	Ih, Ig, Con	Nervous system; respiratory, headache, loss of consciousness; dermis	Liver, ludneys, eyes, upper respiratory, central nervous system	Yes-NTP Yes-IARC No-OSHA	**Low-moderate potential** (Concentrations are relatively high in RFP sludge waste forms. Source llkely would be encountered in a vapor form only—direct exposure.)
Toluene (108-88-3) VD-3.14 IE- 8.82 eV	TLV = 50 ppm OSHA ceiling = 300 ppm	Ih, S, Ig, Con	Irritation of eyes, nose; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); nervousness, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage	Eyes, skm, respiratory system, central nervous system, liver, kidneys, bladder, blood	No	**Low-negligible potential** (Source has been detected in previous vapor samples but is not a dominant solvent in waste inventory. Source likely would be encountered in a vapor form only.)

Table 2-1. (continued)

Compound (CAS#, Vapor Density, and Ionization Energy)	Exposure Limit” (PEL/TLV)	Routes of Exposure[b]	Symptoms of Overexposure[c] (Acute and Chronic)	Target Organs and Systems	Carcinogen? (Source)[d]	Exposure Potential (All Routes)
Trichloroethylene (79-01-6) VD-4.53 IE-9.5 eV	TLV = 50 ppm STEL = 100 ppm OSHA ceiling = 200 ppm	Ih, Ig, Con	Nervous system; headache, respiratory, eyes, pulmonary edema	Respiratory, heart, liver, kidneys, central nervous system	No	**Low-moderate potential** (Concentrations are relatively high in RFP sludge waste forms. Source llkely would be encountered in a vapor form only—direct exposure.)
1,1,1-trichloroethane (71-55-6) VD-4.6 IE-11.1 eV	TLV = 350 ppm STEL = 450 ppm	Ih, Ig, S, Con	Nervous system; dermis; respiratory; eyes; central nervous system, depression; headache	Central nervous system, skin, eyes, cardiovascular system	No	**Low potential** (Source term is from RFP sludge waste forms. Source likely would be encountered in a vapor form only.)
Radionuclides — Am-241, Co-60, Cs-137, Eu-152, Pu-238, Pu-239/240, U-234, U-235, and U-238 (Becker et al. 1998)						
Radionuclides (whole-body exposure)	INEEL = 1.5 rem/year project ALARA dose limit-in accordance with RWP or ALARA task Posting radiation areas in accordance with Companywide Manual 15A, Table 2-3	Whole body	Electronic dosimetry will be used to alert workers to increased gamma radiation fields and hand-held instruments.	Blood forming cells, GI tract, and rapidly dividing cells	Yes	**Low-negligible potential** (The primary source is from waste shipments and active work at Pit 17 in the SDA. Overburden shield waste in SDA pits and contamination are not anticipated.)
Radionuclides (fixed and removable surface contamination)	Posting of contamination areas in accordance with INEEL Companywide Manual 15A, Table 2-3 and 2-4, and OSHA requirements for occupational radiation protection (10 CFR 835.603.f)	Ig, Con	Hand-held instruments (see Table 3-1)	GI tract, ionization of internal tissue	Yes	**Low potential** (A potential exists for encountering contamination only during intrusive tasks in SDA and opening VVET unit system lines.)

a. **MSDSs** for chemicals other than waste types are available at the project.
b. ACGIH 2003 TLV Booklet and OSHA; 29 CFR 1910; 29 CFR 1926, “Safety and Health Regulations for Construction”; and substance-specific standards
c. (Ih) inhalation; (Ig) ingestion; **(S)** skin absorption; (Con) contact hazard.
d. (Nervous system) dizziness, nausea, lightheadedness; (dermis) rashes, itching, redness; (respiratory) respiratory effects; (eyes) tearing, irritation.
e. If yes, identify agency and appropriate designation (ACGIH A1 or ***A2,*** NIOSH, OSHA, IARC, NTP).

Table 2-1. (continued).

Compound (CAS#, Vapor Density, and Ionization Energy)	Exposure Limit” (PEL/TLV)	Routes of Exposure[b]	Symptoms of Overexposure[c] (Acute and Chronic)	Target Organs and Systems	Carcinogen? (Source)[d]	Exposure Potential (All Routes)

ACGIH = American Conference of Governmental Industrial Hygienists
ALARA = as low as reasonably achievable
CFR = *Code of Federal Regulations*
GI = gastrointestinal
IARC = International Agency for Research on Cancer
IE = ionization energy
IH = industrial hygienist
INEEL = Idaho National Engineering and Environmental Laboratory
MSDS = material safety data sheet
NIOSH = National Institute of Occupational Safety and Health
NTP = National Toxicology Program
OSHA = Occupational Safety and Health Administration
OU = operable unit
PCM = personal contamination monitor
PEL = permissible exposure limit
RCS = Retrieval Confinement Structure
RFP = Rocky Flats Plant
RWP = radiological work permit
SDA = Subsurface Disposal Area
STEL = short-term exposure limit
TLV = threshold-limit value
TWA = time-weighed average
VD = vapor density
VVET = vapor vacuum extraction with treatment

Table 2-2. Vapor vacuum extraction with treatment unit monitoring tasks. associated hazards. and mitigation

Organic Contamination in the Vadose Zone Activities	Potential Hazard or Hazardous Agent	Hazard Elimination, Isolation, or Mitigation
• VVET unit operation • Sampling and analysis	1. Radiological contamination—Potential contamination during intrusive activities in SDA overburden soils and opening VVET unit system lines.	1. Overburden layer, RCT surveys with direct-reading instruments, and using RWPs and PPE, as required.
• VVET unit maintenance, construction, and upgrade • Housekeeping	2. Radiation exposure—During adjacent waste movement, disposal operations in Pit 17, and contamination (if encountered).	2. Direct-reading instruments, maintaining a distance of approximately 30 m (100 ft) from Pit 17 waste-handling operations to the closest OCVZ operations, RCT coverage, and wearing PPE as required.
	3. Chemical usage and nonradiological contaminants—During collection of monitoring and soil vapor samples, maintenance and system upgrade tasks, and handling and application of chemical compounds used for operational and maintenance activities.	3. IH coverage, as required, direct-reading instruments, personnel monitoring, hard-plumbed connections, MSDSs, working upwind of potential organic vapor sources during sampling, and wearing PPE as required.
	4. Pinch points, caught-between, and struck-by—During VVET unit component maintenance, installation and removal, vehicle and equipment movement, and material handling.	4. Qualified equipment operators, hazard identification and mitigation training, equipment backup alarms, designated work areas, hand, foot, eye, head, and body protection as appropriate per HSO.
	5. Lifting and back strain—While moving equipment, handling VVET-unit equipment and components, and handling sampling equipment and supplies.	5. Mechanical lifting and movement devices whenever possible, proper lifting techniques (e.g., two-person lifts as required), and lifting no more than 50 lb or 1/3 of personal body weight (whichever is less).
	6. Heat and cold stress—During outdoor work, summer and fall temperatures, and PPE use.	6. IH monitoring, work and rest or warm-up cycles as required, proper selection of work clothing or PPE, and personnel training.

Table 2-2. (continued)

Organic Contamination in the Vadose Zone Activities	Potential Hazard or Hazardous Agent	Hazard Elimination, Isolation, or Mitigation
	7. Hazard noise levels—While conducting operations directly around heavy equipment or blowers.	7. Source identification, IH sound-level monitoring or dosimetry, isolation of source, and hearing protection devices.
	8. Hazardous energy sources—Includes electrical, mechanical, and thermal sources, and elevated materials, pressure vessels or systems, and compressed gas.	**8.** Identify energy source, isolation of energy source (i.e., LO/TO) for all tie-in activities, perform LO/TO in accordance with MCP-3650 or MCP-3651, use trained and qualified LO/TO personnel, and notify all affected workers in area of LO/TO status. Maintain pressure vessels and systems in accordance with PRD-5, "Boilers and Unfired Pressure Vessels," and ANSI requirements, and compressed gas hazards in accordance with PRD-5040, "Handling of Compressed Gases."
	9. Hot surfaces—Includes VVET unit surfaces.	9. Post hazard, train personnel, allow surface to cool before handling during maintenance, and upgrade tasks.
	10. Hoisting and rigging—During VVET unit upgrade, maintenance, and construction tasks.	10. Qualified equipment operators rig and conduct all activities in accordance withMCP-6501, 6502, 6503, 6504 6505, and inspect rigging and equipment before use.
	11. Walking and working surfaces—Potential slip, trip, and fall hazards associated with snow, ice, mud, cords and lines, uneven flooring surfaces and terrain, probes in SDA, and working from scaffolding or other platforms during maintenance and construction activities.	11. Identify potential slip, trip, and fall hazards of project site walking and working surfaces and mitigate or mark where possible; keep working surfaces clear of debris, sand ice, wear required footwear, maintain all scaffold planks free of tripping hazards and debris in accordance with PRD-5103, "Walking and Working Surfaces."

Table 2-2. (continued).

Organic Contamination in the Vadose Zone Activities	Potential Hazard or Hazardous Agent	Hazard Elimination, Isolation, or Mitigation
	12. Ladder hazards—During ascending and descending ladder to working surface, working from ladders during maintenance or construction activities, and accessing VVET-unit-support structures.	12. Ladder training in accordance with PRD-5067, "Ladders"; ensure ladder is on level stable surface and three-point contact with ladder when ascending or descending; use full-body harness and positioning device attached to anchor, as required, to prevent falls.
	13. Fall hazards—While working from scaffolding or elevated working surface higher than 2 m (6 ft), during VVET unit construction and 1.2 m (4 ft) during operation and maintenance activities.	13. Use standard handrail on scaffolding erections, and use in accordance with PRD-5098 "Scaffolding", under direction of a competent person, and ensure fall protection or fall restraint based on the nature of the fall-protection hazard. Fall-protection requirements will be determined by a fall-protection competent person, in accordance with PRD-5096, "Fall Protection."
	14. Overhead hazards—While walking under VVET units and support structures or temporary maintenance or construction structures, and falling materials or debris during elevated work while supporting VVET unit construction or maintenance tasks.	14. Identify and mark overhead hazards where practical, wear head protection (hard hat) as determined necessary by HSO, use toe boards for elevated working surfaces, secure tools and equipment to prevent them from falling, post to prevent entry to overhead hazard (e.g., falling object) areas where appropriate.
	15. Cut, laceration, and puncture hazards—When using hand tools (e.g., pneumatic or electric saws, drills, wrenches, and impact tools) supporting VVET unit maintenance and construction activities,	15. Inspect all hand tools before use; use all tools in accordance with the manufacturer's instructions, ensure all guards are in place; follow requirements of PRD-5101, "Portable Equipment and Handheld Power Tools"; and wear hand, face, and body protection.
	16. Welding, cutting, and grinding hazards—When supporting VVET unit and support structure maintenance and construction.	16. Conduct all welding, cutting, and grinding in accordance with PRD-5110, "Welding, Cutting, and Other Hot Work"; provide fire watch; and hot work permit (SWP).

Table 2-2. (continued).

Organic Contamination in the Vadose Zone Activities	Potential Hazard or Hazardous Agent	Hazard Elimination, Isolation, or Mitigation

ANSI = American National Standards Institute
IH = industrial hygiene
LO/TO = lockout and tagout
MCP = management control procedure
MSDS = material safety data sheet
OCVZ – organic contamination in the vadose zone
PPE = personal protective equipment
PRD = program requirements document
RCT = radiological control technician
RWP = radiological work permits
SWP = safe work permit
VVET = vapor vacuum with extraction treatment

Internal exposure pathways include those listed below

- **Inhalation** of vapors could occur during maintenance or system upgrade tasks requiring a VVET-unit-system line opening, and potentially during soil-vapor sampling and system monitoring. Vapors may cause the signs and symptoms listed in Table 2-1.

- **Skin absorption** of chemical compounds could occur during VVET unit-maintenance and –upgrade tasks. Contact with chemicals could cause irritation of the eyes and skin.

- **Ingestion** of SDA contaminants encountered or chemical compounds used for maintenance activities from incidental hand-to-mouth transfer could result in a potential uptake through the gastrointestinal (GI) tract that may result in GI irritation or systemic reaction.

- **Injection** by breaking the skin, or migration could occur through an existing wound, resulting in localized irritation, contamination, or uptake of soluble contaminants.

Chemical and radiological hazards will be eliminated, isolated, or mitigated to the extent possible during all project operations. Where these hazards cannot be eliminated or isolated through engineering controls, monitoring for chemical and radiological hazards will be conducted (as described in Section 3) to detect and quantify exposures. Additionally, administrative controls, training, work procedures, and protective equipment will be used to hrther reduce the likelihood of exposure to these hazards through the routes of entry listed above. Table 2 summarizes each primary operational activity, associated hazards, and mitigation procedures.

Radiological work permits (RWPs) will be used when required and safe work permits (SWPs) may be used in conjunction with this HASP to provide task- or activity-specific requirements for project operations. When used, these permits will hrther detail specialized PPE and dosimetry requirements.

2.3 Safety and Physical Hazards and Mitigation

Industrial safety and physical hazards will be encountered while performing project operations, maintenance, and construction. Section 4.2 provides general safe-work practices that must be followed at all times. This section describes specific industrial safety and physical hazards and procedures to be followed to eliminate or minimize safety and physical hazards that will be encountered by project personnel.

2.3.1 Material Handling and Back Strain

Construction and maintenance tasks may involve transport and placement of VVET components that could result in personnel injury if improperly lifted. In addition, sampling and monitoring equipment must be transported between SDA soil-gas locations. Applicable requirements from MCP-2739, “Material Handling, Storage, and Disposal,” and MCP-2692 “Ergonomics Program” will be followed. Mechanical lifting devices (e.g., hoists and forklifts) will be used wherever possible to eliminate the need for manual material handling and lifting. Where these devices are not feasible, lifting and material-handling tasks will be performed in accordance with MCP-2692. Personnel will not physically lift objects weighing more than 50 lb or 33% of their body weight (whichever is less) alone.

The industrial hygienist (IH) may conduct ergonomic evaluations of various project operations and maintenance to determine potential ergonomic hazards presented by various material-handling and equipment-use operations. If conducted, the IH will provide recommendations to mitigate these hazards, including additional engineering controls or work practices.

2.3.2 Repetitive Motion and Musculoskeletal Disorders

Project operational tasks (e.g., material-handling, maintenance, and construction tasks) may expose personnel to repetitive-motion hazards, undue physical stress, overexertion, awkward postures, or other ergonomic risk factors that may lead to musculoskeletal disorders. Musculoskeletal disorders can cause a number of conditions including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. The assigned project IH will evaluate project tasks as deemed appropriate and provide recommendations to reduce the potential for musculoskeletal disorders in accordance with MCP-2692.

2.3.3 Working and Walking Surfaces

Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls. Activities inside operating-unit areas will present potential tripping or slip hazards from uneven flooring surfaces, equipment cords, wet surfaces, or floor obstructions. Outside the units in the SDA the potential for slip, trip, and fall hazards will increase during winter months because of ice- and snow-covered surfaces and from installed probes throughout the SDA. All personnel will be made aware of tripping hazards that cannot be eliminated by marking (e.g., probes). All operations personnel will wear required protective footwear with adequate traction sole to hrther mitigate slip and fall potential. Tripping and slip hazards will be evaluated during the course of the project in accordance with PRD-5103, "Walking and Working Surfaces."

2.3.4 Proper Housekeeping to Prevent Slips, Trips, and Falls

Floor surfaces within the VVET units must be maintained, so far as possible, in a clean and dry condition. All walking and working surfaces will be kept clean, orderly, and free of foreign objects to prevent possible slip, trip, and fall hazards. All tools and equipment used during each shift will be placed back in the designated storage location unless required to be left in place during maintenance tasks. Cords and lines will be routed around walkways, stairs, entrances, and exits to eliminate tripping hazards. Any elevated walkways, platforms, and scaffolding used during maintenance or construction activities will be kept clear of potential tripping hazards at all times.

2.3.5 Elevated Work Areas

Personnel performing VVET maintenance or construction tasks or other operations may be required to work on elevated equipment. Construction personnel required to access elevated area above 2 m (6 ft), and operations personnel required to access elevated areas above 1.2 m (4 ft) must be protected from falling by the use of guardrail systems, personal fall-arrest systems, or fall-restraint systems that prevent personnel from approaching the fall hazard, in accordance with PRD-5096, "Fall Protection."

Additionally, the following MCP requirements will be followed as they relate to project operations associated with elevated work:

- MCP-2709, "Aerial Lifts and Elevating Work Platforms"
- PRD-5067, "Ladders"
- PRD-5098, "Scaffolding."

2.3.6 Powered Equipment and Tools

Powered equipment and tools will be used during VVET maintenance and construction activities. Use of this equipment presents potential physical hazards (e.g., pinch points, electrical hazards, flying debris, struck-by, and caught-between) to personnel operating them. All portable equipment and tools will be properly maintained and used by qualified individuals and in accordance with the manufacturer's specifications. At no time will safety guards be removed. Requirements from PRD-5101, "Portable Equipment and Handheld Power Tools," will be followed for all work performed with powered equipment, including hand tools. All tools and cords will be inspected by the user before use.

2.3.7 Electrical Hazards and Energized Systems

Electrical equipment and tools, as well as maintenance and construction of VVET units will require personnel to install, upgrade, or tie-in to VVET and SDA electrical systems. These activities pose shock or electrocution hazards to personnel. For normal operations and maintenance, ground-fault-protected electrical circuits and receptacles—in combination with safety-related work practices—will be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. All electrical work will be reviewed and completed under the appropriate work controls (e.g., technical procedures [TPRs] or work orders). Before conducting electrical work or work on energized systems, hazardous energy of the affected system will be brought to a zero energy state through the use of isolation methods in accordance with the following procedures:

- MCP-3650, "Chapter IX Level I Lockouts and Tagouts"
- MCP-3651, "Chapter IX Level II Lockouts and Tagouts"
- Applicable RWMC supplemental LO/TO procedures for the system or component being worked.

If work on electrically energized systems is necessary, these practices will conform to requirements in PRD-5099, "Electrical Safety"; and Parts I through III of the National Fire Protection Association (NFPA) 70E, "Electrical Safety Requirements for Employee Work Places." Additionally, all electrical and other utilities will be identified before conducting surface penetration maintenance activities in accordance with PRD-22, "Excavation and Surface Penetrations."

2.3.8 Flammable and Combustible Materials Hazards

Diesel fuel will be required for the equipment during maintenance and construction activities. Gasoline also may be required to power portable generators. Flammable hazards include transfer and storage of flammable or combustible liquids in the project operations area. Portable fire extinguishers with a minimum rating of 10A/60BC are located in each of the VVET units to combat Class ABC fires. Additional fire extinguishers will be located on equipment that has exhaust heat sources on or near all equipment capable of generating ignition or having the potential to spark. When storing project chemicals, MCP-2707, "Compatible Chemical Storage," will be consulted. The requirements of PRD-308, "Handling and Use of Flammable and Combustible Liquids," will be followed at all times.

2.3.8.1 Combustible or Ignitable Materials. Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. The assigned fire protection engineer should be contacted if questions arise about potential ignition sources. The accumulation of combustible materials will be strictly controlled in all project operational areas including the surrounding VVET units, propane storage tanks, and SDA area. Class A combustibles (e.g., trash, cardboard, rags, wood, and plastic) will be properly disposed of in appropriate waste containers.

2.3.8.2 Flammable and Combustible Liquids. Fuel used at the project for fueling equipment must be safely stored, handled, and used. Only portable containers approved by Factory Mutual and Underwriters Laboratories (labeled with the contents) will be used to store flammable liquids. All fuel containers will be stored in the following manner:

- At least 14.2 m (50 ft) from any VVET units and ignition sources

- Inside an approved flammable storage cabinet or tank meeting the requirement s of NFPA 30, "Flammable and Combustible Liquids Code"; and PRD-308, "Handling and Use of Flammable and Combustible Liquids."

Portable motorized equipment (e.g., generators and light plants) will be shut off and allowed to cool down in accordance with the manufacturer's operating instructions before being refueled to minimize the potential for a fuel fire. Refueling tasks will be conducted only by qualified fuel-handling personnel.

2.3.8.3 Welding, Cutting, or Grinding. Personnel conducting welding, cutting, or grinding tasks may be exposed to molten metal, slag, and flying debris. Additionally, a fire potential exists if combustible materials are not cleared from the work area. Requirements from PRD-5110, "Welding, Cutting, and Other Hot Work," will be followed whenever these types of activities are conducted. This includes the requirement for a hot work permit (documented on a safe work permit) and designation of a fire watch.

2.3.9 Hot Surfaces

Accessible VVET surface temperature can exceed 125°F and contact could result in burns to the skin. Accessible hot surfaces will be insulated or shielded where feasible or posted with an appropriate caution sign in accordance with PRD-5117, "Accident Prevention Signs, Tags, Barriers, and Color Codes." An infrared thermometer is available for project personnel to measure surface temperatures.

2.3.10 Pressurized Systems.

Pressurized air systems in the form of air compressors may be operated in support of VVET construction, operations, or maintenance. The hazards presented to personnel, equipment, facilities, or the environment because of inadequately designed or improperly operated pressure systems (vessels) include blast effects, shrapnel, fluid jets, equipment damage, personnel injury, and death. These systems can include pneumatic, hydraulic, or compressed-gas systems. The applicable requirements in PRD-5, "Boilers and Unfired Pressure Vessels," must be following addition to the manufacturer's operating and maintenance instructions. This includes inspection, maintenance, and testing of systems and components in accordance with applicable American National Standards Institute (ANSI) requirements.

All pressure systems will be operated within the designed operating pressure range, which is typically 10–20% less than the maximum allowable working pressure. Additionally, all hoses, fittings, lines, gauges, and system components will be rated for the system for at least the maximum allowable working pressure (generally the relief set point). The project safety professional should be consulted about any questions of pressure systems in use at the project site.

2.3.11 Compressed Gases

Compressed gases may be used in support of operations or maintenance tasks. Where required, all cylinders will be used, stored, handled, transported, and labeled in accordance with PRD-5040, "Handling and Use of Compressed Gases." The assigned OCVZ Project safety professional should be consulted about any compressed gas cylinder storage, transport, and use issues.

2.3.12 Equipment and Vehicle Hazards

Industrial vehicles and equipment, including forklifts, may be used during maintenance and construction activities for the OCVZ Project. Associated operations hazards include injury to personnel (e.g., struck-by and caught-between hazards), equipment contact with VVET units or piping, and property damage. All equipment will be operated as intended and in accordance with the manufacturer's instructions or equipment design. Only authorized qualified personnel will be allowed to operate equipment. Personnel near operating equipment must maintain visual communication with the operator, stay out of the swing radius (e.g., cranes or excavators), and avoid walking directly behind running vehicles. The use of a spotter shall be used when there is low visibility or the work area is congested. Personnel must comply with applicable requirements of the following requirements documents:

- MCP-2745, "Heavy Industrial Vehicles"
- PRD-5123, "Motor Vehicle Safety"
- DOE-STD-1090-2001, Chapter 10, "Forklift Trucks."

2.3.13 Excavation, Surface Penetrations, and Outages

Upgrade of utilities or lines servicing the VVET units may require excavation in and around the SDA (outside or above the waste pits or trenches within the SDA). All excavation and surface-penetration activities will be conducted and monitored in accordance with PRD-22, "Excavation and Surface Penetrations." No excavations will be allowed or conducted until the area has been evaluated and an approved subsurface investigation is documented and an excavation permit (Form 432.93) is approved as required by PRD-22. .:

2.3.14 Hoisting and Rigging of Equipment

Hoisting and rigging will be performed in conjunction with VVET unit maintenance, construction, and upgrade tasks. All hoisting and rigging operations will be performed in accordance with MCP-6501, "Hoisting and Rigging Operations", MCP-6502, "Hoisting and Rigging Maintenance", MCP-6503, "Inspection and Testing of Hoisting and Rigging Equipment", MCP-6504, "Hoisting and Rigging Lift Determination and Lift Plan Preparation", MCP-6505, "Hoisting and Rigging Training", and DOE-STD-1090 (current revision) as applicable for these project operations.

- Hoisting and rigging equipment will show evidence of a current inspection (e.g., tag) and be inspected before use by designated operators. Additionally, if mobile crane or boom trucks are used in support of project operations, the operator or designated person for mobile cranes or boom trucks will perform a visual inspection each day or before use (if the crane has not been in regular service) to verify safe operational condition.

Note: The operator or other designated person will examine deficiencies and determine whether they constitute a safety hazard. If deficiencies are found, they will be reported to the safety professional.

2.3.15 Overhead Hazards

Personnel may be exposed to overhead hazards during VVET maintenance and construction activities from hoisting operations and work overhead. Also, walking around or under VVET units and support structures presents an overhead impact (contact) hazard. Sources for these hazards will be identified and mitigated to the extent feasible in accordance with PRD-5103, "Walking and Working Surfaces." In the case of overhead impact hazards, they will be marked by using systems protected by engineering controls where there is a potential for falling debris, in combination with head protection PPE.

2.3.16 Personal Protective Equipment

Wearing PPE will reduce a worker's ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. In addition, PPE can increase the risk of heat stress. Work activities at the task site will be modified as necessary to ensure that personnel are able to work safely in the required PPE. Work-site personnel will comply with PRD-5121, "Personal Protective Equipment"; and MCP-432, "Radiological Personal Protective Equipment." All personnel who wear PPE will be trained in its use and limitations in accordance with PRD-5121 and 29 CFR 1910, Subpart I, "Personal Protective Equipment."

2.3.17 Decontamination

Decontamination procedures for personnel and equipment are detailed in Section 10. These procedures will serve as the primary decontamination method for all personnel and equipment where contamination is encountered. When required, decontamination procedures and applicable MCPs must be followed, and the appropriate levels of PPE must be worn during decontamination activities. Project IH and RadCon personnel will follow MCP-148, "Personnel Decontamination"; companywide safety and health manual MCPs; and general industrial hygiene practices to conduct decontamination tasks. Personnel will wear required PPE at all times during decontamination tasks as listed in Section 5 and as listed on the associated JSA and RWP.

2.3.18 Illumination

The VVET units are provided with lighting through electrical service to each unit. If the power is locked out or down during operational, maintenance, or construction activities, then minimal lighting levels will be provided, in accordance with Table 2-3, through natural light or auxiliary light plants. The assigned IH will determine illumination intensity values with an appropriate calibrated illumination meter.

Table 2-3. Minimum illumination intensities in foot-candles.

Area or Operation	Foot-Candles
General site areas	5
Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.	3
Indoors: warehouses, corridors, hallways, and exitways.	5
General shops (e.g., inside VVET unit mechanical and electrical equipment rooms, and workrooms).	10
Offices	30

VVET = vapor vacuum extraction with treatment

2.4 Environmental Hazards and Mitigation

Potential environmental hazards will present potential hazards to personnel during project operations. These hazards will be identified and mitigated to the extent possible. This section describes these environmental hazards and states what procedures and work practices will be followed to mitigate them.

2.4.1 Noise

Personnel are not expected to be exposed to noise levels that exceed 85 decibel A-weighted (dBA) for an 8-hour time-weighted average (TWA) except when working in the immediate area of heavy equipment, blowers from the hand tools, and compressors that exceed 85 dBA for an 8-hour TWA or an 83 dBA for a 10-hour TWA. Effects of high sound levels (i.e., noise) may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear causing pain and temporary or permanent hearing loss
- Interference with communication that might warn of danger.

Where noise levels are suspected of exceeding 80 dBA, noise measurements will be performed in accordance with MCP-2719, "Controlling and Monitoring Exposure to Noise," to determine if personnel are routinely exposed to noise levels in excess of the applicable TWA (85 dBA for 8 hours of exposure or lower TWA for 10- or 12-hour work-shift exposures).

Note: Exposures exceeding 8-hours per day will be evaluated by the assigned project IH.

Personnel whose noise exposure routinely meets or exceeds the allowable TWA will be enrolled in the INEEL Occupational Medical Program (OMP) (or subcontractor hearing conservation program as applicable). Personnel working on jobs that have noise exposures greater than 85 dBA will be required to wear hearing protection until noise levels have been evaluated and will continue to wear the hearing protection specified by the IH until directed otherwise. Hearing protection devices will be selected and worn in accordance with MCP-2719.

2.4.2 Heat and Cold Stress

Tasks for the OCVZ Project are conducted all year, so the potential exists for both heat and cold stress that could present a potential hazard to personnel. The assigned IH will be responsible for obtaining meteorological information to determine whether additional heat or cold stress administrative controls are required. All operations personnel must understand the hazards associated with heat and cold stress and take preventive measures to minimize the effects. Guidelines from MCP-2704, "Heat and Cold Stress," will be followed when determining work and rest schedules or when to halt work activities because of temperature extremes.

2.4.2.1 Heat Stress. High ambient air temperatures can result in increased body temperature, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, to unconsciousness, to death. In addition, operational tasks requiring the use of PPE or respiratory protection prevent the body from cooling. Personnel must inform their supervisor when experiencing any signs or symptoms of heat stress or observing a fellow employee experiencing such symptoms. Guidelines for heat stress are provided in MCP-2704.

Heat-stress-stay times will be documented by the IH on the appropriate work control document(s) (e.g., SWP, prejob briefing form, or other) when personnel wear PPE that may increase body-heat burden. These stay times will take into account (1) time spent on a task, (2) nature of the work (i.e., light, moderate, or heavy), *(3)* type of PPE worn, and (4) ambient work temperatures. Table 2-4 lists heat-stress signs and symptoms of exposure.

Individuals showing any of the symptoms of heat exhaustion listed in Table 2-4 shall do the following:

- Stop work
- Exit or be helped from the work area
- Remove and decontaminate PPE (as applicable)
- Move to sheltered area to rest
- Be provided cool drinking water
- Call for emergency response support and be monitored by a medic or employee certified in cardiopulmonary resuscitation (CPR) and first-aid until arrival of the emergency personnel

Monitoring for heat-stress conditions shall be performed in accordance with MCP-2704. Depending on the ambient weather conditions, work conditions, type of PPE worn, and physical response of work operations personnel, the IH shall inform the field supervisor or radiological control technician (RCT) of necessary adjustments to the work and rest cycle. Additionally, physiological monitoring may be conducted to determine if personnel are replenishing liquids fast enough. A supply of cool drinking water will be provided in designated eating areas and consumed only in these areas (permission to make water available to personnel in the SDA must be approved by the industrial hygienist and RadCon personnel). Project personnel may periodically be interviewed by the IH, RCT, or safety professional to ensure that the controls are effective and that excessive heat exposure is not occurring. Workers will be encouraged to monitor personal body signs and to take breaks if symptoms of heat stress occur.

Table 2-4. Heat stress signs and symptoms of exposure.

Heat-related Illness	Signs and Symptoms	Emergency Care
Heat rash	Red skin rash and reduced sweating.	Keep the skin clean, change all clothing daily, and cover affected areas with powder containing cornstarch or with plain cornstarch.
Heat cramps	Severe muscle cramps and exhaustion, sometimes with dizziness or periods of faintness.	Move the patient to a nearby cool place; give the patient half-strength electrolytic fluids; if cramps persist, or if signs that are more serious develop, seek medical attention.
Heat exhaustion	Rapid, shallow breathing; weak pulse; cold, clammy skin; heavy perspiration; total body weakness; dizziness that sometimes leads to unconsciousness.	Move the patient to a nearby cool place, keep the patient at rest, give the patient half-strength electrolytic fluids, treat for shock, and seek medical attention. DO NOT TRY TO ADMINISTER FLUIDS TO AN UNCONSCIOUS PATIENT.

Table 2-4. (continued).

Heat stroke	Deep, then shallow, breathing; rapid, strong pulse, then rapid, weak pulse; dry, hot skin; dilated pupils; loss of consciousness (possible coma); seizures or muscular twitching.	Cool the patient rapidly. Treat for shock. If cold packs or ice bags are available, wrap them and place one bag or pack under each armpit, behind each knee, one in the groin, one on each wrist and ankle, and one on each side of the neck. Seek medical attention as rapidly as possible. Monitor the patient's vital signs constantly. DO NOT ADMINISTER FLUIDS OF ANY KIND.

Note: Heat exhaustion and heat stroke are extremely serious conditions that can result in death and should be treated as such. The shift supervisor (526-9993), or Warning Communications Center (WCC) (777 or 526-1515) if the shift supervisor cannot be contacted, should be notified to immediately request that an ambulance be dispatched from the Central Facilities Area (CFA) -1612 medical facility. Concurrently, the affected individual should be cooled as described in Table 2-3 as indicated by the nature of the heat-stress illness.

Low Temperatures and Cold Stress. Personnel will be exposed to low temperatures during fall and winter months or at other times of the year if relatively cool ambient temperatures combine with wet or windy conditions. The IH will be responsible for obtaining meteorological information to determine whether additional cold stress administrative controls are required to comply with MCP-2704.

2.4.3 Ultraviolet Light Exposure.

Personnel will be exposed to ultraviolet light (UV) (i.e., sunlight) when conducting project operations outdoors and during welding tasks. Sunlight is the main source of UV known to damage the skin and to cause skin cancer. The amount of UV exposure depends on the strength of the light, length of exposure, and whether the skin is protected. No UV rays or suntans are safe. The following are mitigative actions that should be taken to minimize sunlight UV exposure:

- Wear clothing to cover the skin (long pants [no shorts] and long-sleeve or short-sleeve shirt [no tank tops])
- Apply sunscreen with a sun protection factor of no less than 15 to areas exposed to the sun
- Wear a hat (hard hat where required)
- Wear UV-absorbing safety glasses
- Limit exposure during peak intensity hours of 10 a.m. to 4 p.m. whenever possible.

Eye protection will be provided for all welding tasks in accordance with PRD-5110, "Welding, Cutting, and Other Hot Work." Additional skin coverage should include long-sleeve shirts and the use of welding screens to prevent UV and other welding hazards from affecting personnel in the adjacent areas.

2.4.4 Confined Spaces

There are no identified confined spaces related to the operation or maintenance of VVET units D, E, or F. If potential confined spaces are identified, then the IH shall be notified to conduct an evaluation prior to entry. The IH shall ensure the confined space is evaluated and requirements implemented per MCP-2749.

Note: No entry shall be made into any permit-required confined space until all permit conditions (e.g., air monitoring, preentry briefing, and required personnel onsite) have been met.

2.4.5 Biological Hazards

The VVET units and support structures provide habitat for various rodents, insects, and vectors (i.e., organisms that carry disease-causing microorganisms from one host to another). The potential exists for encountering nesting materials or other biological hazards and vectors. Hantavirus may be present in the nesting and fecal matter of deer mice. If such materials are disturbed, it can become airborne and create a potential inhalation pathway for the virus. Contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspected rodent nesting or excrement material is encountered, the assigned IH will be notified immediately and no attempt will be made to remove material or to clean the area. Following an evaluation of the area, disinfection and removal of such material will be conducted in accordance with MCP-2750, "Preventing Hantavirus Infection."

Snakes, insects, and arachnids (e.g., spiders, ticks, and mosquitoes) may also be encountered at the project. Common areas to avoid include material stacking and staging areas, under existing structures (e.g., trailers and buildings), under boxes, and other areas that provide shelter. Protective clothing generally will prevent insects from direct contact with the skin. If potentially dangerous snakes or spiders are found or are suspected of being present, the following actions will be performed:

- Warning others
- Keepng personnel away from hazard
- Contacting assigned IH for additional guidance as required.

Insect repellant (DEET or equivalent) may be required. Areas where standing water has accumulated (e.g., evaporation ponds) provide breeding grounds for mosquitoes and should be avoided. In cases where a large area of standing water is encountered, it may be necessary to pump water out of the declivity (areas other than the established SDA ditches and silt basin).

2.4.6 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the project area (e.g., sustained strong winds 25 mph or greater, electrical storms, heavy precipitation, or extreme heat or cold), these conditions will be evaluated and a decision made by the IH, safety professional, RCT, and other personnel, as appropriate, to stop work, employ compensatory measures, or proceed with operational, maintenance, or construction activities.

During all project activities, assigned health and safety professionals in consultation with RadCon personnel and the shift supervisor will determine if wind or other weather conditions pose unacceptable hazards to personnel or the environment.

2.4.7 Subsidence

Subsidence over and adjacent to waste pits and trenches in the SDA is a routine occurrence during the spring months. A Timely Order or similar administrative control will be issued by the shift supervisor about subsidence during these periods that implement subsidence rules. Generally, these rules consist of

(1) the requirement to have communications (radio or cellular phone), (2) enforcement of a 2-person entry rule, and (3) limitations on vehicle access to other than the main roads. All work will be scheduled through the facility planning processes, at which time subsidence safety requirements will be communicated. Some operational, maintenance, and construction activities may be allowed during subsidence periods, but must be authorized by the shift supervisor on a case-by-case basis.

2.5 Radiological Hazards and As-Low-As-Reasonably-Achievable Principles

Section 2.2 provided the extent and nature of contaminants associated with waste disposed of in the SDA. Although the risk from exposure to ionizing radiation during OCVZ Project activities is considered minimal and encountering contamination is unlikely, controls are in place to minimize this potential in keeping with as-low-as-reasonably-achievable (ALARA) principles.

The radiation exposure of OCVZ Project operations personnel will be controlled such that exposures are well below regulatory limits established in "Occupational Radiation Protection" (10 CFR 835) and that no radiation exposure occurs without commensurate benefit. All personnel have the responsibility for following ALARA principles and practices.

Note: Unplanned and preventable exposures are considered unacceptable.

Radiological contamination monitoring will be conducted during OCVZ sampling tasks as described in Section 3.3.2 to ensure that if contamination is detected, RadCon personnel will take appropriate protective measures to minimize the spread of contamination and prevent worker exposures.

All personnel working at the site must strive to keep both external and internal radiation doses ALARA by adopting the practices described below.

2.5.1 External Radiation Dose Reduction

Basic protective measures used to reduce external doses of radiation include the following items:

- Minimizing time in radiation areas
- Maximizing the distance from known sources of radiation
- Using radiation protection shielding.

Personnel will adhere to all radiological postings in the SDA, wear required dosimetry, and contact an RCT if contamination is suspected of being encountered during any OCVZ Project task. An RWP may be written for specific OCVZ operations and tasks, as deemed appropriate by RadCon personnel and in accordance with MCP-7, "Radiological Work Permit."

2.5.2 Internal Radiation Dose Reduction

An internal dose of radiation is a result of radioactive material being taken into the body. Radioactive material can enter the body through inhalation, ingestion, absorption through wounds, or injection from a puncture wound. Reducing the potential for radioactive material to enter the body is critical to avoiding internal doses of radiation. Monitoring for contamination will be conducted using hand-held instruments and air-sampling equipment in accordance with MCP-139, “Radiological Surveys”; MCP-357, “Job-Specific Air Sampling/Monitoring”; and as deemed appropriate by RWMC RadCon personnel.

2.6 Other Project Hazards

All OCVZ Project personnel should employ hazard-recognition training to identify potential hazards and immediately inform their supervisor and appropriate safety personnel (safety professional, IH, RCT, health and safety officer [HSO]) of the hazards so that action can be taken to correct the condition. All personnel have the authority to initiate STOP WORK actions in accordance with MCP-553, “Stop Work Authority,” if it is perceived that an imminent safety or health hazard exists, or to take corrective actions within the scope of the work control authorization documents to correct minor safety or health hazards and THEN inform their supervisor.

Personnel working at the project are responsible to use safe-work practices, report unsafe working conditions, near misses or unsafe acts, and exercise good housekeeping habits during project operations with respect to tools, equipment, and waste.

2.7 Site Inspections

The VVET technician, IH, safety professional, RCT, and other project personnel may participate in project-site inspections during the work-control-preparation stage of the project (e.g., hazard identification and verification walkdowns), and conduct self-assessments or other inspections. Additionally, periodic safety inspections will be performed by supervisors and assigned health and safety professionals in accordance with MCP-3449, “Safety and Health Inspections.”

Targeted or required self-assessments will be performed during project operations in accordance with MCP-8, “Self-Assessment Process for Continuous Improvement,” as directed by the project manager. All inspections and assessments will be documented and available for review by the project manager, as a minimum. Health and safety professionals present during project operations may, at any time, recommend changes in work habits to the OCVZ operations. However, all changes that may affect the project written work control documents (e.g., TPRs and work orders) must have concurrence from the appropriate technical discipline representative onsite and may require preparation of a Form 412.11, 2001, “Document Management Control Systems (DMCS) Document Action Request (DAR),” for the applicable document as required.

3. EXPOSURE MONITORING AND SAMPLING

The potential for exposure to chemical, radiological, and physical hazards exists during VVET unit operation, maintenance, construction, and sampling and analysis tasks. The mitigation strategy for these hazards includes the following:

- Refining VVET access requirements and work control zones (see Section 7)
- Using engineering and administrative controls
- Training workers
- Wearing PPE.

Monitoring and sampling will be used throughout project operations to (1) assess the effectiveness of engineering controls, (2) determine the appropriate PPE requirements for individual tasks, and (3) determine the need for upgrading and downgrading of PPE as described in Section 5. Monitoring with direct-reading, stationary, and hand-held instruments will be conducted to provide RadCon and IH personnel with real-time and trending data to assess the effectiveness of control measures.

Tables provided in this section present the strategy for conducting exposure monitoring and sampling. These include:

- Table 3-1: Tasks and hazards to be monitored and monitoring instrument categories
- Table 3-2: Monitoring instrument category and description
- Table 3-3: Action limits and associated responses for specific hazards

3.1 Nonradiological Occupational Exposure and Action Limits

Threshold-limit values (TLVs) and other occupation exposure limits (OELs) have been established for numerous chemicals and physical agents (e.g., noise, heat, or cold stress) that may be encountered. These exposure limits provide guidelines in evaluating airborne, skin, and physical-agent exposures. A TLV represents a level and conditions under which it is believed that nearly all workers may be exposed day after day without adverse health effects. The TLV-TWA is a TWA concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects.

Action limits provided in Table 3-3 (instantaneous concentrations for short time periods) have been established to hrther reduce the likelihood of exceeding TLVs or as regulatory triggers for additional medical surveillance and actions. These concentrations for nonradiological contaminants of concern are provided in Table 2-1. The purpose of establishing action limits is to prevent the OEL from being exceeded. The project IH will evaluate each VVET unit and SDA sampling location using real-time monitoring and compliance sampling, as described in Section 3.3, based on site-specific conditions and professionaljudgment. Individual action limits will apply only to specific hazards or contaminants listed in Table 3-1. If action limits are reached, personnel will take the appropriate actions as listed. Upgrades to PPE will only be required if (1) the threshold for the particular level of PPE being currently worn is exceeded or (2) another type of contaminant is introduced. No hrther upgrade would be required unless the protection factor was exceeded.

Table 3-1. Tasks and hazards to be monitored, frequency, and monitoring instrument category.

Tasks	Hazard(s) to be Monitored"	Instrument Category to be Used
VVET operation	Radionuclide contamination—(alpha, beta, gamma)	2
	Chemical constituents—waste organic vapors	3, 4
	Respirable dust—silica and other particulates of concern	3, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
	Hot surfaces	9
Sampling and analysis	Ionizing radiation—(alpha, beta, gamma – near Pit 17)	1
	Radionuclide contamination—(alpha, beta, gamma)	2
	Chemical constituents—waste organic vapors	3, 4
	Respirable dusts and other particulates of concern	3,4,5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
VVET maintenance, construction, and upgrades	Radionuclide contamination—(alpha, beta, gamma)	2
	Chemical constituents—waste organic vapors	3, 4
	Respirable dust—silica (area and personal)	3, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
	Hot surfaces	9
	Confined space entry	3, 4, 10

a. Monitoring and sampling will be conducted as deemed appropriate by project Industrial Hygiene and RadCon personnel based on specific tasks and site conditions.

VVET = vapor vacuum extraction with treatment

Table 3-2. Monitoring instrument category and description.

Instrument Category	Instrument Category Number Description”
1	**Alpha:** Count rate—Bicron/NE Electra (DP-6 or AP-5 probe) or equivalent. Stationary—Eberline RM-25 (HP-380AB or HP-380A probe) or equivalent. **Beta-gamma:** Count rate—Bicron NE/Electra (DP-6, BP-17 probes) or equivalent. Stationary—Eberline RM-25 (HP-360AB probe) or equivalent.
2	**Airborne contamination:** Grab sampler—SAIC H-810 or equivalent.
3	**Organic vapor:** Direct-reading instruments (photoionization detector, flame ionization detector, or infrared detector), passive sampling techniques (e.g., OVM badges), detector tubes, or grab samples. **Dust:** Direct-reading instrument (miniram or equivalent).
4	**Organic vapors and other airborne constituents, particulate or hazardous atmospheres:** Personal sampling pumps with appropriate media for partial and full-period sampling using NIOSH or OSHA-validated methods, direct-reading instruments, or remote sensing detectors.
5	**Silica dust, respirable:** NIOSH 7500 or equivalent, personal sampling pump, respirable-size-cut cyclone, full-period sampling.
6	**Noise:** ANSI Type S2A sound level meter or ANSI S1.25-1991 (ANSI 1991) dosimeter (A-weighted scale for TWA dosimetry, C-weighted for impact dominant sound environments).
7	**Ergonomic stressors:** Observation and ergonomic assessment of activities in accordance with MCP-2692, “Ergonomic Program,” and ACGIH TLV.
8	**Heat stress:** wet-bulb globe temperature, body weight, fluid intake. **Cold stress:** ambient air temperature, wind chill charts.
9	**Direct heat source:** Infrared thermometer (or equivalent)
10	**Oxygen/lower explosive limit:** Direct-reading multigas meter with O_2/LEL sensors.

a. Equivalent instrumentation other than those listed may be used.

ACGIH = American Conference of Governmental Industrial Hygienists
ANSI = American National Standards Institute
LEL = lower explosive limit
MCP = management control procedure
NIOSH = National Institute for Occupational Safety and Health
OSHA = Occupation Safety and Health Administration
SAIC = Science Applications International Corporation
TLV = threshold limit value
TWA = time-weighted average

Table 3-3. Action limits and associated responses for project operational hazards.

Contaminant or Agent Monitored	Action Limit	Response Taken if Action Limit is Exceeded
Nonradiological particulates (insoluble or poorly soluble) not otherwise specified	>10 mg/m^3 (inhalable fraction) >3 mg/m^3 (respirable fraction)	1. Substitute equipment or change method to reduce emissions at source 2. Verify engineering control operation (where in place) or institute engineering controls 3. Evaluate air movement (wind) conditions and reschedule tasks or reposition personnel to position upwind of source 4. Move task to alternate location (with engineering controls if possible) 5. Use wetting or misting methods to minimize dust and particulate matter 6. IF wetting or misting methods prove ineffective, THEN don respiratory protection" (as directed by IH) or reschedule task.
Nonradiological airborne contaminant (chemical, dust fume, fiber, or particulate)	Based on individual contaminant exposure limit (ACGIH TLV or OSHA PEL) and 29 CFR 1910 or 1926 substance-specific requirements. Generally, sustained levels at the TLV or PEL in the worker's breathing zone for 2 minutes should be used as the action limit. Where a lower OSHA substance-specific action limit exists, these values should be used as the action limit.	1. Substitute equipment or change method to reduce emissions at source 2. Verify engineering control operation (where in place) or institute engineering controls 3. Evaluate air movement (wind) conditions, reschedule tasks, or reposition personnel to position upwind of source 4. Move task to alternant location (with engineering controls if possible) 5. IF engineering and administrative controls do not control contaminant below action limit, THEN reevaluate engineering and administrative controls or don respiratory protection" (as directed by IH) 6. IF OSHA substance-specific standard action limit is exceeded, THEN initiate applicable medical surveillance requirements.

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Limit	Response Taken if Action Limit is Exceeded
Nonradiological hazardous atmosphere Chemical IDLH, oxygen deficient, oxygen enriched, 10% of chemical LEL	As defined by MCP-2749, confined spaces are based on criteria such as oxygen level, individual contaminant IDLH value, and LEL. **Note:** *No entry into an area or space containing a hazardous atmosphere is permitted without authorization by the project manager, or representative, in conjunction with health and safety professionals This authorization will be demonstrated through the use of approved operational procedures or other work control documents.*	1. Eliminate hazardous atmosphere through use of engineering controls. 2. Reschedule operations when area or space will not have hazardous atmosphere. 3. Evaluate space or area to be entered. IF the operation can be conducted outside the area or space, THEN perform operation without entry. 4. Measure atmosphere before initiating operation or personnel entry and verify acceptable entry conditions have been met (e.g., oxygen and LEL). In addition, use engineering controls (blower) to maintain safe atmosphere and below specified exposure limit. Use confined space permit to authorize entry. 5. IF engineering control fails to control contaminant below safe atmospheric and exposure limit, THEN stop operation and evacuate personnel until safe atmosphere and specified entry conditions can be achieved. 6. IF IDLH atmosphere must be entered, THEN don appropriate air-supplied respiratory protection (with escape capacity) and protective clothing.”At least one stand-by person dressed in proper PPE must be present for each entrant. **NOTE:** *The INEEL fire department also must be notified for any area or space entry into an IDLH atmosphere to ensure adequate rescue equipment and resources are in place.*

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Limit	Response Taken if Action Limit is Exceeded
Hazardous noise levels	<85 dBA 8-hour TWA or equivalent TWA for 10- or 12-hour exposure.	No action.
	85 to 114 dBA or equivalent TWA for 10- or 12-hour exposure.	1. Isolate noise source or place sound-absorbing barrier in noise path
	(a) >115 dBA	(a) Isolate source, evaluate noise-reduction rating for single device, use double protection as needed.
	(b) >140 dBA	(b) Control entry around source and isolate source, only IH-approved double hearing protection to be worn.
Radiation field	<5 mrem/hour	
	5 to 100 mrem/hour @ 30 cm (10 CFR 835.603b, "High Radiation Area")	2. Prejob planning and dry runs as deemed appropriate 3. Placement of shielding as feasible Required posting: Caution, Radiation Area Supplemental posting: RWP and Personnel Dosimeter Required for Entry Required training: Radiological Worker I or II training

Table 3-3. (continued).

Contaminant or Agent Monitored	Action Limit	Response Taken if Action Limit is Exceeded
	>100 mrem to 500 Rad @ 100 cm (10 CFR 835.603b)	**No entry unless authorized by the project manager (or designated alternate) and RadCon management in conjunction with the radiological engineer.** 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing (as applicable) 4. Placement of shielding as feasible. Required posting: Caution or Danger, High Radiation Area Supplemental posting: Personnel Dosimeter, Supplemental Dosimeter, and RWP Required for Entry' Required training: Radiological Worker I (with high radiation area training) or II training
Radionuclide contamination	Removable contamination levels 1 to 100 times the values in Table 2-2 of the INEEL RCM[b] (10 CFR 835.603d, "Airborne Radioactive Area")	Bioassay submittal (as required) Respiratory protection (as deemed appropriate) Required posting: Caution or Danger, High Contamination Area Supplemental posting: RWP and Protective Clothing Required for Entry Required training: Radiological Worker II training

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Limit	Response Taken if Action Limit is Exceeded
	Removable contamination levels >100 times the values in Table 2-2 of the INEEL RCM[b] (10 CFR 835.603d)	**No entry unless authorized by the project manager (or designated alternate) and RadCon management in conjunction with the radiological engineer.** 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing 4. Supplied breathing air (as deemed appropriate) Bioassay submittal (as required). Required Posting: Caution or Danger, High Contamination Area Supplemental posting: RWP and Protective Clothing Required for Entry Required training: Radiological Worker II training
Response to abnormal radiological conditions or alarms	Supplemental radiation dosimetry or area radiation monitor alarm	1. Stop work activities and place the area in a safe condition (i.e., secure excavator equipment and terminate activities that may result in more severe conditions) 2. Alert others 3. Affected individuals exit the area 4. Notify RadCon personnel.

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Limit	Response Taken if Action Limit is Exceeded
	Personal Contamination Monitor alarm	1. Remain in the immediate area 2. Notify RadCon personnel 3. Take actions to minimize cross-contamination (e.g., putting a glove on a contaminated hand) 4. Take follow-up actions in accordance with Article 541 of the INEEL RCM[c] Article 541.
	Spill of radioactive material	1. Stop or secure the operation causing the spill" 2. Warn others in the area 3. Isolate the spill area if possible 4. Minimize individual exposure and contamination 5. Secure unfiltered ventilation 6. Notify RadCon personnel.
Other facility or INEEL alarms	Project operations, RWMC or INEEL alarm	See Section 10.6 for emergency response action following facility or INEEL alarms.

a. Respiratory protection and clothmg as prescribed by the project IH and RadCon personnel (based on contaminant of concern). See Section 5 for additional PPE requirements.
b. *Manual 15 -Radiation Protection – INEEL Radiological Control* (PRD-183).
c. Access requirements may be deleted or modified if personnel access is specifically prohibited.
d. For radioactive spills involving highly toxic chemicals, workers should immediately exit the area without attempting to stop or secure the spill. They should then promptly notify the IH and INEEL HAZMAT team and Project RadCon personnel.

Contaminant or Agent Monitored	Action Limit	Response Taken if Action Limit is Exceeded
		OSHA = Occupational Safety and Health Administration OU = operable unit PCM = personal contamination monitor PEL = permissible exposure limit PPE = personal protective equipment RadCon = Radiological Control RCM = *Radiological Control Manual* (PRD-183) RWMC = Radioactive Waste Management Complex TLV = threshold limit value TWA = time-weighted average

Exposure to nonchemical hazards (e.g., hazardous noise) and physical hazards will be controlled by implementing existing INEEL MCPs and PRDs in conjunction with processes outlined in STD-101 and PRD-25, “Activity Level Hazard Identification, Analysis, and Control.” New or previously unidentified hazards shall be reported to appropriate health and safety or RadCon personnel.

3.2 Environmental and Personnel Monitoring

The potential for exposure to chemical hazards and radiological contamination exists during VVET unit maintenance and system openings, intrusive activities in the SDA, and during monitoring tasks. Delineation of a designated work area (see Section 7), engineering and administrative controls, worker training, and the use of PPE will be used to mitigate these hazards. However, potential exposure to these contaminants cannot be eliminated. Environmental and personnel monitoring will be conducted to determine effectiveness of these exposure-control practices and assist health and safety, and RadCon professionals in establishing additional administrative controls and PPE requirements. Safety hazards and other physical hazards will be monitored and controlled, as outlined in Section 2.

Industrial Hygiene and RadCon personnel will conduct monitoring with direct-reading instrumentation, collect contamination-control swipes, and conduct full- and partial-period air sampling during project activities in accordance with applicable MCPs, OSHA substance-specific standards, as stated on project operational RWPs, and based on professional judgment. Instrumentation listed on Table 3-2 (or equivalent) will be selected based on the site-specific conditions and contaminants associated with project tasks. The RCT and IH will be responsible for determining the best monitoring technique for radiological and nonradiological contaminants (respectively). Safety hazards and other physical hazards will be monitored and mitigated as outlined in Section 2.

Industrial hygiene and environmental sampling has been conducted during operation of VVET units in the SDA. Results indicate that personnel are not exposed to hazardous levels in excess of OELs. The IH sampling data is maintained in the Hazard Assessment Sampling System (HASS) and is available upon request to the IH.

The environmental monitoring data, details of the emission-modeling technique, and meteorological conditions, including worker exposure and exposure risk assessment, were documented in an engineering design file, “Operable Unit 7-08 Air Dispersion Modeling and Health Effects from Thermal Oxidation Unit Emissions at the Radiological Waste Management Complex” (EDF-1901). It is available from document control, and can be reviewed with the IH upon request.

3.2.1 Industrial Hygiene Area and Personal Monitoring and Instrument Calibration

The assigned project IH will conduct full- and partial-period sampling of airborne contaminants and monitoring of physical agents during operations at a frequency deemed appropriate based on direct-reading instrument readings and changing conditions. When performed, all air sampling will be conducted using applicable National Institute of Occupational Safety and Health (NIOSH), OSHA, or other validated methods. Personal and area sampling and remote-sensing monitoring may be conducted

Various direct-reading instruments may be used to determine the presence of nonradiological and other physical agents. The frequency and type of sampling and monitoring will be determined by OCVZ Project conditions, direct-reading instrument results, observation, professional judgment, and in accordance with MCP-153, “Industrial Hygiene Exposure Assessment.”

All monitoring instruments will be maintained and calibrated in accordance with the following:

- Manufacturer's recommendations
- Existing IH protocol
- MCP-2391, "Control of Measuring and Test Equipment"
- Companywide safety and health manuals, Manual 14A – Safety and Health, Occupational Safety and Fire Protection and Manual 14B - Safety and Health Occupational Medical and Industrial Hygiene.

Calibration information, sampling and monitoring data, results from direct-reading instruments, and field observations will be recorded as stated in Section 12.

3.2.2 Radiological Monitoring and Instrument Calibration

Radiological monitoring of radiation and contamination will be conducted as deemed appropriate to ensure that personnel are given adequate protection from potential radiological exposure. Direct-reading instruments will be used as the primary method for detection of radiological contamination. Instruments and sampling methods listed in Table 3-2 may be used by the RCT as deemed appropriate and as required by general or task-specific RWPs. When conducted, monitoring will be performed in accordance with *Manual 15B - Radiation Protection Procedures* and *Manual 15C - Radiological Control Procedures.* Data obtained from monitoring will be used by RadCon personnel to evaluate the effectiveness of engineering controls, decontamination methods and procedures, and to alert personnel to potential contamination sources.

All portable survey instruments will be source-checked daily to ensure they are within the specified baseline calibration limits. Accountable radioactive sources will be maintained in accordance with MCP-137, "Radioactive Source Accountability and Control." All radiological survey and monitoring equipment will be maintained and calibrated in accordance with the following:

- Manufacturer's recommendations
- Existing RadCon protocol
- Companywide Manual 15B
- MCP-93, "Health Physics Instrumentation."

3.2.3 Personnel Radiological Exposure Monitoring

Personal radiological monitoring will be conducted to quantify radiation exposure and potential for uptakes as stated in the applicable general or task-specific RWP. This will include using external dosimetry, surface monitoring, and internal dosimetry methods to ensure that engineering controls, administrative controls, and work practices are effectively mitigating radiological hazards. General ALARA considerations are discussed hrther in Section 2.5.

3.2.3.1 External Dosimetry. Dosimetry requirements will be based on the radiation exposure potential during project tasks. All personnel (other than visitors) who enter the SDA will be required, at a minimum, to wear a thermoluminescent dosimeter and other personal dosimetry devices (e.g., albedo dosimetry) specified by RadCon personnel in applicable RWPs, and in accordance with the *Manual 15A - INEEL Radiological Control Manual* (RCM) (PRD-183).

The Radiological Control and Information Management System will be used to track external radiation exposures to personnel and to serve as the administrative control mechanism for working in accordance with individual RWPs. All personnel are responsible for (1) ensuring required personal information is provided to RadCon personnel for entry into that Radiological Control and Information Management System and (2) logging in when electronic dosimeters are used.

3.2.3.2 Internal Monitoring. Internal monitoring is not anticipated for OCVZ Project activities. If contamination is encountered, then internal dosimetry (event-based bioassay) will be specified by the RWMC internal dosimetry coordinator and on an RWP. Project personnel are responsible for submitting all required bioassay samples on request.